SCIENCE

FRIDAY, MAY 5, 1899.

CONTENTS:

*'OBSERVATIONS OF THE PLANET MARS.'**

THIS is the first volume of a series which promises to be important for the physical study of the planets. It contains a detailed account of the observations made on the planet Mars during an interval of ten months (June, 1894—March, 1895) by Mr. Percival Lowell and his two collaborators, W. H. Pickering and A. E. Douglass. The observatory, especially constructed near the small town of Flagstaff, occupies a central position in the great plateau of Arizona, at an elevation of 7,250 feet above the level of the sea, in latitude 35° 11′ and longitude 111° 40′ west of Greenwich. The choice of that location has been justified by the success attained. During the six months from June to November, 1894, the planet could be observed on nearly every day. On two days out of three it was possible to record useful observations of difficult objects. The atmospheric conditions prevailing during that period (and often during the following winter as well) are sufficiently characterized by the discovery of a great number of details unknown to previous observers. These observations suffice to give an idea of the optical perfection of the instrument employed, which had an objective by Brashear,

* Annals of the Lowell Observatory. Vol. I.—Observations of the Planet Mars during the opposition of 1894–95, made at Flagstaff, Arizona. Percival Lowell, Director of the Observatory. Boston and New York, Houghton, Mifflin & Co. 1898. Pp. xii + 392. Large quarto. Plates, xxi.

of 18 inches aperture and 315½ inches focal length. The magnifying powers used were commonly 440 and 617; an eye-piece of power 820 served for the micrometric measurements. Among the auxiliary instruments we mention an Arago polariscope, which has been employed, perhaps for the first time, upon Mars by W. H. Pickering at Flagstaff; also a scale of very fine lines of different sizes, which served for the comparison and estimation of the size and intensity of the lines observed on the planet.

The very numerous and varied observations which form the contents of the present volume have led to many results, the most important of which have been announced by Mr. Lowell in his book 'Mars,' published in 1895. That book contains many discussions and theories of great interest as to the physical constitution of the planet and its atmosphere, its habitability, and as to the most plausible manner of explaining the curious phenomena which have been observed. The substance of those researches and of those discussions has been reproduced in the present volume. The readers of SCIENCE have been made familiar with them by the critical analysis of them given by Professor W. W. Campbell in the number for August 21, 1896. I have, therefore, not occupied myself with the theoretical and hypothetical portions, and I am able to confine myself to the observations. In view of their great variety, I shall be obliged to limit myself to the consideration of some of the more characteristic points.

First, as to the polar spots and their periodic variations, which are known to be analogous to those of our polar snows. The manner of development of the polar caps and the phases of their increase are entirely unknown, and it is probable that they will always remain so; for during the period of their increase they are for the most part or wholly enveloped in the night of the pole. But the process of their dissolution can be followed without much difficulty when the inclination of the planet's equator with respect to our line of vision approaches the maximum value possible, which occurred in 1894. As for that, the observers at Flagstaff have been able to study the phenomena of the southern spot from the beginning of June, when its diameter was about 55°, up to its total (or nearly total) destruction, which occurred toward the end of October.

They were able to follow the changes of its size and shape, its division into several parts by the large black band, and to establish further the persistence of certain parts isolated from the greater body. They also observed the changes of color which took place in the surrounding dark regions. Plate II., page 46, gives the definitive results of that investigation, which, in comparison with similar work hitherto, sufficiently shows the superiority of the means with which Mars has been visually studied at Flagstaff.

I may be permitted to express here the conviction that it is by the exact and persevering study of the polar spots of Mars that we shall some day arrive at a sound knowledge of the physical nature of that planet, and the interpretation of its singular phenomena. I shall even venture to say that if the southern cap is very instructive in that respect, the northern cap is still more so. In fact, the latter develops to a large extent over the regions of a yellow color which it is customary to call continents. The obscure band which reaches to its edge has a direct relation to the system of canals and lakes surrounding it. In the same measure as the white spot diminishes under the influence of the solar rays, there take place in the neighboring regions very considerable changes, the connection of which with the successive phases of the cap is evident. The facts that I was able to

establish during the oppositions of 1886 and 1888 make me very strongly wish that the northern cap could be studied by the observers at Flagstaff with the same success as the southern.

A considerable portion of the work is devoted to the phenomenon which is called, according to usage, the *canals* of Mars, the nature of which is still entirely obscure, despite the theories, oftentimes pretty and very ingenious, which they have occasioned.

Mr. Lowell has given a description of these singular formations which seems to me to conform to the truth in the great majority of cases. He has succeeded in showing their character quite well in his drawings. See plates I, IV, V, VI. If there is any defect here, it is that the differences of the size and intensity of the different canals are not indicated with sufficient clearness. I have had occasion to gain some experience in that line of work, and I have no hesitation in saying that this part of the observations at Flagstaff seems to me to be worthy of the greatest consideration. Between the south pole and the thirtieth parallel of north latitude (three-quarters of the whole surface of the planet) previous observers have more or less clearly recognized the existence of 70 or 80 canals. At the Lowell Observatory that number has at one stroke been increased to nearly 200, without counting those whose existence could not be satisfactorily verified. The record of observations of these objects made from June 6, 1894, to April 3, 1895, occupies no less than 85 pages. Frequently 20 or 30 canals could be seen together. In less than an hour, on the night of October 6th, 42 were made out on a portion of the planet which did not amount to a quarter of the whole surface. All three observers took part in the work. The newly discovered canals naturally belong to the most difficult class, and a certain number of them have since been verified by two European observers, Leo Brenner at Lussinpiccolo and Cerulli at Teramo. I greatly regret that I am unable to add my own name to those, but my eye no longer has the power necessary for successfully carrying out such difficult observations.

Several canals were observed in a state of gemination, among others Ganges, Nectar, Euphrates and Phison. On the 8th of October Mr. Douglass made the very curious and remarkable observation of the gemination of the *Lacus Solis*, which seemed to be divided in two by a luminous band on the extension of Nectar. I made a similar observation in 1890, but then the luminous band was on the prolongation of Eosphoros. The same thing is being observed by M. Cerulli at Teramo during the current opposition of 1899.

As a result of these numerous discoveries and other subsequent ones, as well as future ones, areography is coming to find itself in a condition which may be called an embarrassment of riches. The network of canals has become so complex that there begins to be considerable difficulty in orienting oneself. Imagine three or four hundred of these lines traced all together over a globe of but a few seconds of apparent diameter! The identity of lines seen by different observers at almost the same place is very often doubtful. The difficulty of seeing well and of precisely locating the coordinates of the two extremities may easily give rise to ambiguity and errors. Add to this the frequent changes which the lines undergo in their aspect and their degree of visibility; being now fine and sharp, and again large and diffuse; sometimes double, often entirely invisible—and one is no longer astonished to see the same line, observed by two different men in a slightly different manner, regarded by them as two distinct objects; or, on the other hand, to see two essentially different objects confounded as a single one. The better remedy for avoiding these inconveniences

would be to give up the doubtful objects, and to make as complete and exact a study as possible upon those canals best known and most easily observed, following without interruption the variations of their aspect and of their course, and basing deductions upon precise measures. Precise measures ! the thing most necessary and at the same time the most difficult, which ought to receive more attention from skilled observers.

The proportion of new discoveries at Flagstaff on the small dark spots called lakes (Mr. Lowell's *oases*) is relatively still more considerable. Prior to the opposition of 1894 ten to twelve of these formations were known. Mr. Lowell gives a catalogue of more than forty of them. He has shown that in most cases these oases are arranged in regular series on the routes of the longer canals. It is quite probable that minute dark spots, more or less readily visible, must exist at all points of intersection of any two canals.

There is still another class of objects on which the Flagstaff observers have instituted the first thorough research. These are the black lines which furrow the darker portions of the surface of Mars and are ordinarily called the seas. Some lines of that sort had been noticed before, and even a form of gemination had been established for two of them.* In general, previous observers had believed that they saw here lines of the greatest faintness rather than true canals; in only a very few special cases did they succeed in tracing the two edges distinctly. At Flagstaff these lines have been observed and reproduced with much care by Mr. Douglass, who seems to have a very sensitive and well-trained eye for that sort of objects. From measures of position angles he traced on two maps their course in the dark regions of the planet and their connection with the canals of the yellow region. See plates XII and XIII.

The third chapter of the volume is also the work of Mr. Douglass, and deals with a class of observations which are almost unknown, except for some essays in this direction at Nice and at the Lick Observatory in 1890 and 1892. I refer to the irregularities which have been very often noticed at the terminator, *i. e.*, on the line which at any instant separates the obscure from the illuminated hemisphere. These are very evident when the phase is considerable, near the quadratures. In by far the greater majority of cases these irregularities are merely optical illusions caused by the different proportion of the oblique solar illumination returned to us in the different regions traversed by the terminator. But there seem to be certain of these irregularities which can only be explained by the presence of elevations or depressions on the surface of Mars. Still others seem to depend upon the presence of very high clouds. These investigations are of much interest, not only from their possible bearing on the topography and orography of Mars, but also from the point of view of the physical history of the planet and its atmosphere.

The work is enriched by a large number of drawings of Mars, some of which are really excellent even from an artistic point of view. See especially plates I and IV. We have seen nothing as beautiful since the drawings made by Mr. Green on his expedition to Madeira in 1877. We can recognize here not only the geometrical configurations and the varieties of light and shade, but we can also get some idea of the magnificent coloration observed on the planet.

The chart placed at the end of the vol-

*See on my map of 1882 the two parallel lines which include between them the large island called *Noachis;* one of these is named *Prasodes* on Cerulli's map. See also the two lines which flank the right side of *Syrtis Magna* on my drawing of June 20, 1890, published by Flammarion (*La Planète Mars*, p. 476).

FIG. 1. Normal milk-bag of ewe showing two nipples.

FIG. 2. One rudimentary extra nipple.—A Sport.

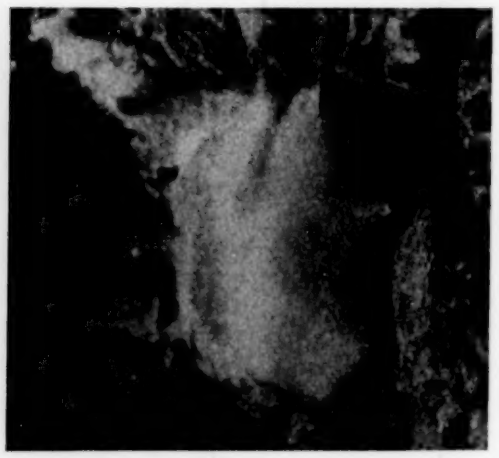


FIG. 3. Two rudimentary extra nipples. — A Sport.

FIG. 4. Ewe born 1892, nipples increased by selective breeding.

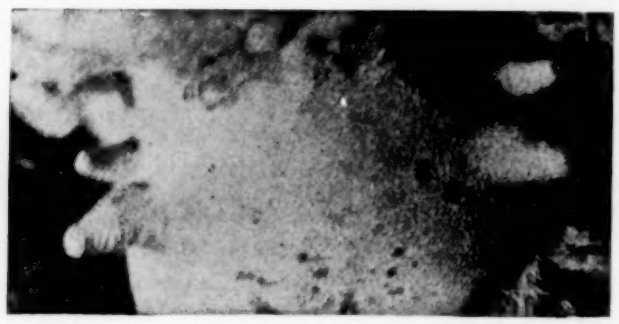


FIG. 5. Ewe born 1893, nipples increased by selective breeding.

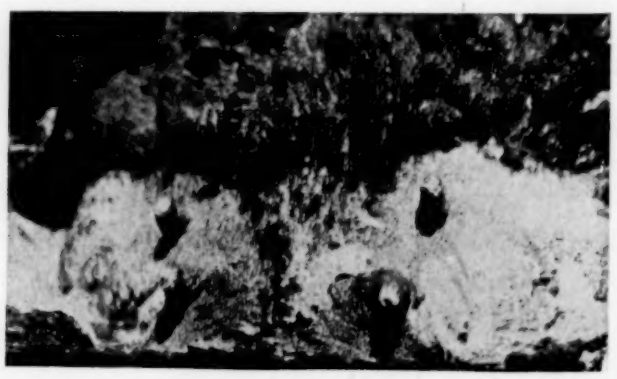


FIG. 6. Ewe born 1895, nipples of equal size increased by selective breeding.

ume is a simple schematic representation, I venture even to say a little too schematic. Each object is designated by a number, and the corresponding name is to be sought in the special tables of regions, canals and oases. This makes the use of the chart troublesome and comparison with other charts inconvenient. All the large and small canals, of whatever degree of importance and visibility, are treated in a uniform manner and are represented by lines of equal intensity; and the same with the oases, with the exception of the largest one of all, called the Lake of the Sun. It is not easy to recognize promptly on the chart many of the objects which are ordinarily seen at the first glance and which are familiar to areographers. Such objects as Indus, Oxus, Ganges, Cyclops, Trivium and Elisium must be sought in an inextricable maze of lines. We have here not a simple index, but one which in use requires itself an index.

I will close this incomplete description of the work on Mars at Flagstaff with the expression of a hope and a wish, namely, that so important a publication should not be limited to a single opposition. The exact and complete knowledge of Martian phenomena demands that the planet should be examined under all possible inclinations of its axis and during all seasons of its year. This requires observations continued at least through *seven* consecutive oppositions. I say, 'at least,' for if the terrestrial seasons are far from following the annual period with mathematical precision, the phenomena of Mars seem still more divergent; and the existence of other periods, longer and more complex, ought to be included among the possibilities. Nevertheless, I think that if we could have before us seven volumes similar to the one under review, and corresponding to a complete cycle of seven oppositions, many facts would be revealed of which we are at present ignorant, and many others of which we have at present only dubious indications; especially would this be the case if the seven volumes were the work of the same observers. I therefore hope and wish, as do many others, that Mr. Percival Lowell may be in a position to continue the work so happily begun; that he will soon publish the results of the observations during the opposition of 1896–97, and that the same means which he has employed for the study of the southern hemisphere of Mars may be applied to the still more important observation of the phenomena of the northern hemisphere.*

G. SCHIAPARELLI.

MILAN, March 1, 1899.

ON THE DEVELOPMENT BY SELECTION OF SUPERNUMERARY MAMMÆ IN SHEEP.†

IN the year 1890 Dr. Bell found that 50 % of the lambs born upon his farm in Nova Scotia were twins, and he made an examination of the mothers in order to ascertain whether the twin-bearing ewes differed in any noticeable degree from those which produced single lambs.

Thirty-three per cent. of the twin-bearing ewes were found to possess supernumerary mammæ in a more or less rudimentary condition, whereas among the ewes having single lambs only 22% possesssed the peculiarity; 43 % of the ewes having supernumerary mammæ bore twin lambs, whereas only 30% of the normally-nippled ewes had twins.

Although the absolute numbers were far too small to yield reliable percentages, they afforded some ground for the idea that the extra-nippled ewes were more fertile than the others; and Dr. Bell thought it would be interesting to ascertain (1) whether by

* Translated from the author's MS. in French by E. B. F.

† Abstract of a paper read before the National Academy of Sciences at Washington, D. C., April 19, 1899, by Alexander Graham Bell.

selective breeding the supernumerary mammæ could be developed from their rudimentary condition into real functional nipples yielding milk, and (2) whether in this case the fertility of the ewes would be increased.

In the autumn of 1890 his shepherd, Mr. John McKillop, made an examination of the mammæ of 890 sheep belonging to farmers in the island of Cape Breton, Nova Scotia. In 811 cases, or 91 %, the sheep were normally nippled, having only two nipples each. In 79 cases, or 9%, supernumerary mammæ were present in a more or less developed condition. Some of these sheep had three nipples, others four, a few five, and one ewe had six nipples. In 52 cases, or 6%, the extra nipples were so rudimentary as to resemble pimples upon the milk bag. In 27 cases, or 3%, the extra-nipples, though much inferior in size to the ordinary-nipples, seemed to be sufficiently developed to be functional; and most of these sheep were purchased by Dr. Bell and added to his flock.

Dr. Bell presented statistics showing the results of ten years selective breeding for supernumerary mammæ. The following tables show the number and percentage of lambs born each year having 2, 3, 4, 5 or 6 nipples, and the accompanying chart exhibits the percentages in graphical form:

Table I.

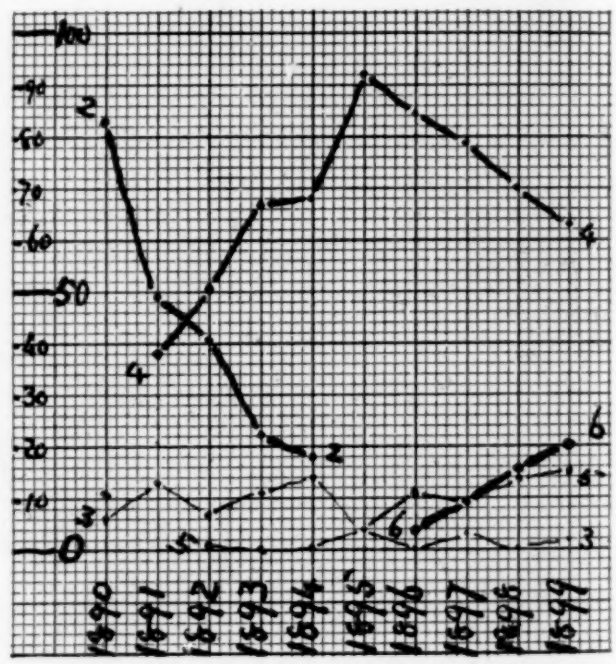
Number of Lambs born each year from 1890 to 1899.

Years of Birth	Total Lambs	Number of Mammæ				
		2	3	4	5	6
1890	71	59	4	8	—	—
1891	78	38	10	30	—	—
1892	71	29	5	36	1	—
1893	67	15	7	45	—	—
1894	22	4	3	15	—	—
1895	26	—	1	24	1	—
1896	27	—	—	23	3	1
1897	34	—	1	27	3	3
1898	37	—	—	26	5	6
1899	41	—	1	26	6	8

Table II.

Percentage of Lambs born each year from 1890 to 1899.

Year of Birth	Total Lambs	Number of Mammæ				
		2	3	4	5	6
1890	100 %	83 %	6%	11%	—	—
1891	100 "	49 "	13 "	38 "	—	—
1892	100 "	41 "	7 "	51 "	1%	—
1893	100 "	22 "	11 "	67 "	—	—
1894	100 "	18 "	14 "	68 "	—	—
1895	100 "	—	4 "	92 "	4%	—
1896	100 "	—	—	85 "	11 "	4%
1897	100 "	—	3 "	79 "	9 "	9 "
1898	100 "	—	—	70 "	14 "	16 "
1899	100 "	—	2 "	63 "	15 "	20 "



Graphical Chart showing the percentage of lambs born each year from 1890 to 1899 having 2, 3, 4, 5 or 6 nipples (See Table II.).

In the autumn of 1893 the flock was cut down very severely, and only those ewes were retained which had supernumerary mammæ in a functional condition. This accounts for the small number of lambs born in 1894. Since that time no ewe lambs have been retained excepting those having extra nipples large enough to yield milk.

No normally-nippled lambs (2-nippled) have been born in the flock since 1894. Three-nippled lambs are gradually disap-

pearing. Four-nippled lambs increased from 11% in 1890 to 92% in 1895, since which time the percentage has gradually fallen, the four-nippled lambs being replaced by five and six-nippled lambs. The first six-nippled lamb was born in 1896, and the percentage has increased from 4% in 1896 to 20% in 1899.

Dr. Bell claimed that his statistics showed that he had produced by selection a breed of sheep possessing supernumerary mammæ as a normal condition.

Figures are given on Plate V. showing the normal milk-bag of a ewe, extra nipples occurring as sports and the extra nipples obtained by selective breeding.

LATEST VOLCANIC ERUPTIONS OF THE PACIFIC COAST.

THE date of the last volcanic eruption on the Pacific coast of the United States, exclusive of Alaska, has long been a matter of doubt, and will probably remain so for many years to come. Speaking geologically, much of the material in the great volcanic field of the Northwest, including a large part of Oregon and Washington, with portions of California, Idaho and Wyoming, is of comparatively recent eruption. The outbursts may have begun in the Eocene, were most violent and extensive during the Miocene and Pliocene, and, diminishing in vigor, extended, perhaps, up to the borders of the historical period. In Alaska, however, there have been eruptions from Bogoslov, St. Augustin and other volcanoes as late as 1883 and even later, and there can be no question concerning the reliability of the testimony. G. F. Becker gives a list (U. S. G. S., 18th Ann. Rept., Part III., p. 14) of over forty volcanoes in Alaska which have been reported active within historical times.

The evidence, so far as the Pacific States are concerned, is given chiefly by Professor J. D. Whitney (The United States, 1889, p. 114), Major C. E. Dutton (SCIENCE, Vol. VI., p. 46), Professor George Davidson (SCIENCE, Vol. VI., p. 262), and Dr. H. A. Harkness, (Proc. of the Cal. Acad. of Sci., Vol. V., p. 408). Although there are no new facts at hand definitely fixing the date of the last eruption in that region, there has recently come to my attention some information having a bearing upon other evidence.

Last summer Mr. Frederick V. Coville, Botanist of the Department of Agriculture, while studying the flora of Mt. St. Helens, in Washington, found some interesting fragments of charcoal, which he transmitted to the Director of the U. S. Geological Survey, with the following letter:

"I collected two pieces of coniferous charcoal at the point where the trail from Lake Merrill to Mt. St. Helens crosses the Kalama River. Each came from a short charred piece of tree trunk about two feet long and a foot in diameter. My attention was first called to them by Colonel J. J. Hawkins, of Portland. The pieces of charcoal were caught with other fresh drift material brought down the Calama from Mt. St Helen's in last spring's flood. They were charred all the way to the center as evenly and thoroughly as the fragments sent you.

"The character of the charcoal, which need not be described in detail here, is such as at first to suggest that it was made in a very carefully prepared kiln. There are, however, no charcoal pits in the region, and the charcoal from forest fires has a very different character. It is evident from the peculiarities of the flora of Mt. St. Helens, and from its limited erosion, that it is a mountain of very recent volcanic origin. Among other phenomena presented by it was one which, although it did not come under my own observation, is well substantiated by people of the region, and furnishes an explanation of the peculiar sections of charred logs found at the crossing of the Kalama. The phenomena described is the occurrence of molds of tree trunks at various points in the lava flows about the base of Mt. St. Helens. In some places these molds occur in large numbers and lie in the beds in either a horizontal or a vertical position. They are sometimes thirty feet in length, and bear the impress of the bark of the tree in the minutest details. Though I was unable to visit the places where these tree molds occur, I talked with at least half a dozen men who had seen these casts, but none of

them had seen charred wood or bark in the holes. Presumably charcoal was formed only where the lava flow so completely covered the trees as to shut out the air, and the pieces found had been eroded by the Kalama River from wholly submerged molds."

Mr. Coville's conclusion as to the formation of the charcoal is probably correct. Mr. F. H. Knowlton, who studied the structure of the charcoal, recognizes the wood as Douglas spruce (*Pseudotsuga mucronata*). Attention was called (*Nat. Geog. Mag.*, Vol. VIII., p. 226) several years ago to the tree molds or tree wells by Captain P. Elliott. Through Mr. J. H. West, of Woodland, Washington, Mr. F. A. Walpole, one of Mr. Coville's assistants, secured a piece of the basaltic lava from one of these tree molds three feet in diameter. The piece of lava shows the impressions of the bark in great detail. In the hope of obtaining some evidence concerning the age of the lava flow associated with the tree molds and charcoal I entered into correspondence with Mr. West, who reports charred logs at least forty yards up the slope from the high-water mark of Kalama River. One of the charred logs is twenty-eight inches in diameter, and some of them are partly woody, not having been completely converted into charcoal. Near the River at one point the charred logs are found under six feet of sand and gravel, on which are now growing fir trees having a diameter of three feet. Some of the charred logs, therefore, appear to be at least 100 years old, for a fir three feet in diameter would probably require at least that length of time to attain its present size. If this be true it is probable that some of the charred logs are not the result of the last eruption of St. Helens, but of an earlier one. There is historical evidence furnished by Fremont (Memoirs, p. 282) to the effect that Mt. St. Helens and also Mt. Baker were in eruption November 23, 1843. At that time a light fall of ashes occurred at the Dalles, Oregon, on the Columbia, fifty miles from Mt. St. Helens, which was then noted as being in a state of eruption. Rev. Mr. Brewer collected some of the ashes and gave them to General Fremont, who visited the Dalles a year later. Mt. Baker is thought to have been in eruption at the same time, and the natives report that the fish in the Skagit River were killed by its ashes. Mr. S. F. Emmons gives (*Jour. of the Am. Geog. Soc.*, Vol. IX., p. 53) the testimony of a former Hudson Bay trader who saw an eruption of Mt. St. Helens in the winter of 1841–2.

It is hoped that the question may be settled some time in the near future by a geological survey of both Mt. St. Helens and Mt. Baker. While it may not be possible to establish the date exactly, the geological records upon the mountain slope are likely to be such as to give the relative age with certainty. The case of the cinder cone, ten miles northeast of Lassen Peak, California, may be noted as an example of the results of investigation in the field. Professor Harkness was of the opinion that the eruption occurred in January, 1850. The freshness of the material was so striking that Major Dutton and I, who visited the region in 1885, were at first of the same opinion, but fuller investigation, an account of which is published in the U. S. Geological Survey Bulletin No. 79, shows conclusively that the explosive eruption from the cinder cone must have occurred long before the beginning of the present century.

J. S. Diller.

U. S. Geological Survey,
Washington, D. C., April 22, 1899.

THE PROSPECTIVE PLACE OF THE SOLAR AZIMUTH TABLES IN THE PROBLEM OF ACCELERATING OCEAN TRANSIT.

It is not generally recognized that science, employing the mathematician and the engineer alike in the problem of shortening the duration of ocean transit, has accomplished

as much by causing ships to go fewer miles as by causing them to go faster.

This generation is familiar with the part that has been played by steam propulsion in increasing the speed of ships, but, besides the increase in the rate of travel, modern motive power, by making possible a departure from the old meteorological routes, has had another and a greater effect in the progress of the universal policy of civilized nations to accelerate transit from place to place to the utmost possible extent. When the wind was the sole motor of ocean-going vessels the best economy was realized by passing through regions of favorable meteorological conditions without reference to the directness of the route. Thus, in sailing from Europe to the United States, it was customary to pass southward along the eastern shores of the Atlantic to the Cape Verde Islands, and thence westward through the trade-wind region along the route followed by Columbus on his first voyage to the New World, and finally northward into the region of prevailing westerly winds and along the western shores of the Atlantic to the point of destination. In making this voyage, ships traversed 4,400 miles in passing between ports that were only 2,400 miles apart on the surface of the earth.

Under steam, even if they go no faster, ships may yet get farther toward the port of destination in a given time because the winds and currents may be disregarded, and they may be navigated over the oceans along great circles of the earth.

The increasing recognition among mariners of the sound principle of conducting a ship along the arc of the great circle joining the points of departure and destination and the expanding sense of the advantages to be gained by a knowledge of this branch of nautical science have greatly heightened the value of methods which place the benefits of the knowledge and use of the great-circle track at the service of the mariner without the labor of the calculations which are necessary to find the series of courses to be steered. Inasmuch as great-circle courses alter continuously in proceeding along the track, it becomes necessary to know the latitude and longitude of the ship in order to determine the course to be followed. At the present day there are convenient means for determining at sea the longitude as well as the latitude, but before the early part of the present century these means did not exist, and great-circle sailing was impracticable. The general lack of the application of the principles of the great circle in later times, and even in the present generation, seems to have resulted not from the want of recognizing that the shortest distance between any two places on the earth's surface is the distance along the arc of the great circle passing between them, nor that the great-circle course is the only true course and that the courses in Mercator and parallel sailing are circuitous, nor yet to a due appreciation of the advantages to be gained by a knowledge of the great-circle course as a means for obtaining the most advantageous track in windward sailing; but to the tedious operations which have been necessary, and to the want of concise methods for rendering these benefits readily available.

The solution, every time the course must be determined, of a spherical triangle in which the two sides and the included angle are given is a formidable operation for a mariner as compared with the measurement on a compass diagram of the direction of the straight line representing the circuitous path of the ship's track on the Mercator chart. At page 662 of the ninth edition of a work on Practical Navigation by Captain Lecky, of the Royal Naval Reserve of Great Britain, there is a section entitled 'Great Circle Courses found from Burwood's Tables,' which has doubtless been

read with profit by thousands, for it states that "to find the great-circle courses from the azimuth tables you have only to regard the latitude of the port bound to as declination, and the difference of longitude, turned into time, as the hour-angle. The latitude of the ship you take from the top of the page as usual." But the author goes on to remark that, as Burwood's solar azimuth tables extend only to twenty-three degrees of declination, this ready-made method is only applicable when the place of destination is within the tropics.

It may be of value, therefore, to point out that the solar-azimuth tables are universally applicable for finding great-circle courses, because all great circles pass into the tropics, and, if the problem of finding the courses is with reference to a great-circle track between a point of departure and a point of destination, both lying outside of the tropics, it is only necessary to find a point lying on the prolongation of the great-circle arc beyond the point of actual destination and within the tropics, and treat this point as the place of destination in finding the courses.

The longitude of the selected point within the tropics may be found without any calculation by simply prolonging the straight line representing the great circle upon a gnomonic chart. By this combination of the gnomonic chart and the azimuth tables the courses upon a great circle track may be determined with very great facility.

To illustrate, take the problem of finding the initial course on a voyage by the great circle route from Bergen, in latitude 60° N. and longitude 5° E., to the Strait of Belle Isle, in latitude 52° 1′ 2″ N. and longitude 55° W. On a copy of a gnomonic chart, such as Godfray's, draw a straight line between the geographical positions above stated and extend it beyond the latter into the tropics. It will be found to intersect the 20th degree parallel of latitude in longitude 90° W., or 95° from the meridian of the point of departure. Entering the azimuth table at latitude 60°, under declination 20°, and opposite hour-angle 95° or 6h. 20m., we find the required course to be N. 75° 31′ W.

G. W. Littlehales.

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*SOME NEW AMERICAN FOSSIL FISHES.**

The following new occurrences of fossil fishes were reported: (1) A species of *Cladodus*, scarcely distinguishable from *C. striatus* Ag. in the Corniferous Limestone of Ohio. (2) *Thelodus*-like scales from same horizon. (3) A pair of naturally associated pectoral spines of *Machæracanthus* from the Hamilton, near Buffalo, N. Y. (4) A ptychopterygian pectoral fin from Naples Shale of the same locality. (5) Two new species of *Diplodus* from Upper Devonian near Chicago, Ill. (6) Teeth of *Phœbodus* from Keokuk Limestone of Iowa and Permian of Nebraska. (7) Largest known spine of *Stethacanthus* (length over 35 cm.) from Keokuk Group, Iowa. (8) A complete fin, spines and shagreen scales of a new and very large species of *Acanthodes*, a genus not hitherto met with in the United States, from Coal Measures of Mazon Creek, Ill. (9) *Pholidophorus americanus* sp. nov., also belonging to a genus new to this country, founded on very perfect material discovered by N. H. Darton, of the U. S. Geological Survey, in the Jura of the Black Hills, South Dakota.

Photographs of the new Jurassic fishes were exhibited and their specific characters summarized as follows: Gracefully fusiform, upwards of 15 cm. long, the head forming about one-fourth the total length and slightly less than maximum depth of trunk; dorsal arising behind pelvic fins; scales not serrated, thin, smooth, nearly rhomboidal, overlapping; flank series not

* Abstract of a paper read before the Boston Society of Natural History, March 15, 1899.

especially deepened. This places them among the more primitive members of the genus, and hence would seem to indicate a Lower Jurassic horizon.

The distribution of American Devonian fishes was discussed with reference to those of other countries. During the Lower Devonian there was none, and in the Upper scarcely any intermingling of United States and Canadian vertebrate faunas, but those of Canada and Great Britain belonged to a distinct province. Corniferous fishes of Ohio and New York are most nearly related to those of the Middle Devonian of continental Europe, especially the Eifel, Bohemia, etc. The Hamilton faunas of New York and the Mississippian region, including Manitoba, are the direct successors of the Corniferous, but the Chemung of both eastern and western regions (or its equivalent) contains a remarkable mixture of indigenous types and intruders from all directions. Intercommunication between eastern Canada and Great Britain, Spitzbergen, etc., became general for the first time during this period. The transition between Devonian and Carboniferous faunæ is now known to be more gradual than was formerly supposed.

The only natural basis of family classification among *Arthrodires* was held to be through comparison of the sutures of cranial and dorsal shields, the differences in dentition being of only secondary importance. Degeneracy of the latter in *Titanichthys*, etc., is paralleled by that in certain toothless whales (*Mesoplodon*, etc.). Cranial osteology of *Homosteus* and *Heterosteus* compel their removal from *Coccosteidæ* to form a separate family called *Homosteidæ*. In this family the so-called antero-dorso-lateral corresponds to the like-named element in *Dinichthys* and *Titanichthys* plus the clavicular. The latter plate functioned as a support for the gills, and hence may be interpreted as a modified branchiostegal apparatus, but in no sense as a part of the shoulder-girdle. There is no evidence that any of the *Arthrodires* possessed pectoral fins. The obvious resemblance of this group to Ostracoderms, with implied relationship, is lost sight of through its removal by Woodward to the Dipnoi, and there seems to be sufficient evidence for regarding the *Arthrodira* as a distinct sub-class, of equal rank with Lung-fishes, Teleostomi, etc., as already suggested by Dean.

CHARLES R. EASTMAN.

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*RAPIDITY OF SAND-PLAIN GROWTH.**

THE undisturbed character of the stratified deposits making up the sand-plains, taken in connection with the absence, or at most, the very slight development of constructional back-sets, indicates, as was early pointed out by Davis, a stationary ice margin during the period of deposition. It follows, therefore, that their formation must have been extremely rapid, and the natural conclusion is that they represent the deposits of a single summer's period of melting, an interval not over eight months in length.

It occurred to me that a calculation based upon the conditions now existing in the large glaciers of Alaska might give some indication as to the probability of such estimates, or at least would be of interest in this connection.

To make this calculation it is simply necessary to divide the bulk of the sediments by the daily discharge of detritus by the glacial stream which deposited them. This involves factors which are usually very difficult to determine, but at the sand-plain near the railroad station at Barrington, R. I., the conditions are almost ideally perfect, and admit of the determination with considerable accuracy of both the bulk of

* Abstract of paper read before Boston Society of Natural History, February 15, 1899.

the sediment and the size and velocity of the stream transporting it. Owing to the fact that observations as to the amounts of the fine clay-like detritus of glacial streams are more numerous and reliable than those upon the coarser material, the bulk of the contemporaneous clays was taken as a basis of calculation, rather than the sand-plain itself. In estimating the load of the glacial stream, I have taken the maximum value of 13 grams per liter, given by Reid for the Muir Glacier (the highest value on record), as the one which, in all probability, would most nearly correspond to the load of a glacial stream during the closing stages of the continental ice sheet.

At the time of the formation of the Barrington clays the land stood at a level of at least forty feet below that at present existing, and the deposition took place in an inclosed bay, having the ice sheet as its northern boundary, a ridge of till and modified drift for its eastern boundary, and an earlier sand-plain as its southern boundary. On the west was a broad and deep opening, connecting with Narragansett Bay, and admitting of a complete commingling of the salt and fresh waters. Into this inclosed bay flowed a stream with a width, as indicated by its esker, of 150 feet, a depth of some 20 feet, and an average velocity of not over 5 feet per second. On the assumption that the amount of sediment was 13 grams per liter, the daily discharge of clayey material would have been some 526,500 tons per day.

Experiments recently conducted by Professor W. O. Crosby in connection with professional work for the Metropolitan Water Board of Massachusetts, the results of which he has kindly placed at my disposal, indicate that material such as the clay beds are essentially composed of, *i.e.*, quartz-flour, settles with great rapidity, and it can be shown that practically the entire amount of sediment brought in by the glacial stream must have been deposited within the inclosed bay described.

The clays cover about a square mile in area, have a maximum thickness of 60 feet, and a total bulk of 95,300,000 tons. Dividing this bulk by the daily discharge of sediment by the glacial stream (526,500 tons), the time of deposition of the clays is indicated to have been 181 *days*, or almost exactly six months.

The Barrington deposits probably represent very nearly average conditions; hence a period of six months seems a fair estimate of time for the formation of a simple sand-plain of moderate size. In the case of large plains, with areas of several or many square miles, the period of deposition may be considered as extending over more than one season of melting, there being in the meantime either no retreat of the ice margin or a retreat so slight that the intervening space was completely filled and the sand-plains united into a single compound plain.

Myron L. Fuller.

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*PROPOSED SURVEY OF THE NILE.**

The Egyptian government has agreed to undertake a survey of the Nile with the object of determining the species of fishes inhabiting its waters. It is due in the first instance to the efforts and energetic action of Dr. John Anderson, F.R.S., who has already done so much to enlarge our knowledge of the fauna of Egypt that this important project, to which so much scientific interest is attached, has now taken definite shape. A memorandum prepared by him, setting forth his proposals for the survey and the lines of his scheme for carrying it out, received the approval of Lord Lister, President of the Royal Society; Professor E. Ray Lankester, Director of the Natural History Departments of the British Museum; Dr. A. Günther, President of the Linnæan Society, and Mr. P. L. Sclater, Secretary of the

*From the London *Times*.

Zoological Society, and was then forwarded by him to Lord Cromer, to be submitted to the Egyptian government, with a strong recommendation for its favorable consideration from these eminent scientific men. The Trustees of the British Museum furthermore gave the scheme their powerful and influential support, and intimated their willingness to assist in a practical manner by undertaking to supply the necessary collecting-boxes, with alcohol to fill them. An essential feature of the scheme is that the fishes collected are to be sent to London to be studied and determined by Mr. Boulenger, the ichthyologist on the staff of the Museum, and the Trustees have, it is understood, agreed to give him every facility for doing this, thus practically placing the services of their officer at the disposal of the Egyptian government for the purpose for the three years which it is estimated will be required to accomplish the survey.

Our knowledge of the fishes of the Nile appears to be very imperfect. It may be said to have taken its origin in 1750, when Hasselquist described thirteen species found in the Deltaic area or in its immediate proximity. In 1847 sixty probably represented the number of known species. In 1861–63 Petherick made, at Dr. Günther's request, a collection of fishes from the Nile for the British Museum. The specimens were obtained at Cairo, Khartum and Gondokoro, and were described by Dr. Günther in an appendix to Petherick's 'Travels,' published in 1889. The collection contained eighteen new additions to the fauna, and raised the number of known species to eighty-two. Since 1869 the fishes of the Nile have been almost completely neglected. At present about ninety species are known to inhabit the river, but this number, considering the vast extent of its waterway and the very diverse physical conditions which characterize many parts of its course, cannot be considered as at all approaching finality.

The collections hitherto made from the Nile have principally been obtained from below the First Cataract; indeed, Rüppell and Petherick are the only two collectors who had opportunities to investigate the river above Assuan. The former distinguished traveler and naturalist largely collected in lower Egypt, and not a few of Petherick's specimens were from the same region. In Dr. Günther's account of this collection only six species were distinctly recorded as coming from Gondokoro, Khartum and the White Nile, while thirteen, besides the foregoing six, species were stated to belong properly to the reach of the Nile above the Sixth Cataract. Here it may be observed that, while we possess a fragmentary knowledge of the species from Khartum southwards, the immense tract of the Nile from the First to the Sixth Cataract remains practically untouched.

Morever, as within the next few years a change will be effected in the distribution of the Nile waters by the construction of the controlling powers now in course of erection at Philæ and Assiut, and as other similar structures or dams are likely to follow towards the south, all of which are certain ultimately to limit more or less the range of certain species of fishes, it is much to be desired that, before any of these triumphs of the Department of Irrigation have been completed, we should be placed in possession of the main features and present condition of the piscine flora of the great reaches of the river.

The present time is also extremely opportune for the commencement of the proposed investigation, since the authorities of the Congo Free State have satisfactorily inaugurated a survey of the Congo. Mr. G. A. Boulenger has been entrusted, with the sanction of the Trustees of the British Museum, with the description of the fishes of the Congo for the Congo Free State, and, as his services will be at the disposal of the

Egyptian government for the Nile exploration, the two surveys should mutually benefit each other. The materials afforded by the one cannot but throw light upon those of the other, many of the species of the two great rivers being closely allied.

As regards the scope and working of the survey, it is suggested, as a preliminary step, that a series of stations should be established along the river, extending, at intervals, from the Delta to Lado, in the territory leased by the Egyptian government to the Congo Free State, and as far to the south of this as possible. Instructions for collecting fishes, written in English and Arabic, will be sent to some responsible official in each of these localities, accompanied by a collecting box and alcohol, supplied by the British Museum, while the services of fishermen and others will be enlisted in the work, a fair price being paid to them for the fishes they collect.

Dr. Keatinge, the officer in charge of the Museum of Natural History of the Medical School of Cairo, has been entrusted with the general supervision of the service of the survey. He will see to the reception of the collecting materials from the British Museum, to their distribution to the different stations, to their reception when returned filled with fishes, and to forwarding them to London. The actual superintendence of the working of the survey is to be undertaken by an officer, who will be constantly on the river at all seasons, visiting the different stations, inspecting the collections formed, making sure that everything possible is being done to obtain fishes, and generally satisfying himself that the specimens are properly preserved, and that they are fairly representative. He will also particularly note the physical characters of the river at each station, find out as much as possible about the habits of the fishes, the depth at which they are found, the general character of the river bed, the seasons in which the fishes breed, and the nature of their food. He will further be required to satisfy himself that the native names have been correctly recorded in Arabic and rightly applied.

Mr. Leonard Loat has been appointed to this responsible post of superintendent of the survey, and on him will devolve the task of seeing that the work is carried out in a thoroughly efficient manner. He left London a short time ago for Cairo, and has already commenced operations on Lake Menzaleh. During the first year it is proposed to carry the investigation as far as Wady Halfa; in the second year the river will be worked between Wady Halfa and Berber, and in the third year it is hoped to continue the survey to Sobat, and, if conditions are favorable, through the *sudd* and rapids between Lado and Dufile, and, ultimately, perhaps to carry the exploration of the river to its origin in the Albert Nyanza. In this connection it may be stated that the assistance of the authorities of the Congo Free State has been invited, and an assurance of their hearty coöperation has, it is understood, been received informally, leaving no room for doubt that an official expression to the same effect will be shortly forthcoming.

These are the lines on which the projected survey of the Nile is to be conducted. It is obvious that, apart from the mere knowledge of how many species of fishes exist in the river, great economic questions will come to the front when their life-history is studied. Also it is hoped that the survey may help to elucidate many problems relating to the fishes sculptured on the ancient monuments of Egypt. Dr. Anderson is taking special pains to obtain drawings of as many of these fish forms as possible, and he regards it as not improbable that a scientific investigation of the fishes obtained in the river will lead to an identification of many of the species represented in stone. These

questions, however, can never be usefully determined until there exists on record a basis on which to work, in the form of a detailed description on each species accompanied, as far as practicable, by a figure. The scheme, therefore, includes provision for the publication of the scientific results in a book uniform with the sumptuous volume which Dr. Anderson has recently issued on the 'Reptiles and Batrachians of Egypt.' This work forms the first volume of the 'Zoology of Egypt.' He is at present engaged in working out the collections of mammals on which the second volume will be based. The 'Fishes of the Nile' will form the third volume of this monumental record of the fauna of the country.

SCIENTIFIC BOOKS.

Birds. By A. H. EVANS, M.A., Clare College, Cambridge. London, Macmillan & Co., Limited; New York, The Macmillan Company. 1899. 8vo. 144 text cuts. Pp. xvi + 635. Price, $3.50.

Mr. Evans's 'Birds' forms Vol. IX. of the 'Cambridge Natural History,' and is intended as a popular systematic review of the class Aves. In a volume of 650 pages it is, of course, impossible to treat in much detail any of the one hundred and thirty odd families of birds, or to particularize respecting many of the 12,000 to 13,000 or more species now recognized by systematists. It would seem, however, that a little more space might have been profitably given to the generalities of the subject, as structure, classification, geographical distribution, migration, etc., all of which is compressed into the short space of twenty-two pages, of which three are devoted to the terminology of the external parts of a bird. The remarks on classification and geographical distribution are mainly historical. Mr. Evans adopts, with 'some slight modifications,' Dr. Gadow's scheme of classification and Sclater's scheme of geographical areas. In referring to the wide differences of opinion among authorities on the subject of genera and species he says: "It cannot be denied that genera and species are merely 'convenient bundles,' and that divisions of either, if carried too far, defeat the object for which classification is intended. Genera are only more distinct from species, and species from races, because the intervening links have disappeared; and if we could have before us the complete series which, according to the doctrine of evolution, has at some time existed neither genus nor species would be capable of definition any more than races in many cases; while the same remark will apply to the larger groups." While such statements are not new they have not been presented in popular works, the lay reader being allowed to retain the old idea of the tangible nature of generic and specific groups. The tendency among certain systematists to recognize subspecies on the basis of the slightest recognizable differences leads naturally to the multiplication of genera, and the increase of subfamilies, etc., to conform, so to speak, to the new unit of measurement consequent upon the recognition, in nomenclature, of the grade of differentiation that is considered as a sufficient basis for 'races' or subspecies. It is to this, doubtless, that Mr. Evans alludes as being likely to 'defeat the object for which classification was intended.'

Beginning with *Archæopteryx*, and ending with the Finches, the various groups of birds are passed briefly in review. The characters of the ordinal, subordinal and family groups are succinctly stated, and some little account is given of the number, distribution and habits of the species, the latter usually in general terms. Very little is said about any particular species, though sometimes a characteristic member of a group is taken as the subject of more definite remark, or in cases where the number of species is so few that something may be said of each. The reader may be thus often disappointed, in seeking information regarding particular species, to find little, if any, reference to the object of his search. In a work of the dimensions of the present volume this must be inevitable, yet it will prove a convenient source of information on the general subject of bird life throughout the world. References to more detailed accounts of species or groups of particular interest are, however, often supplied in foot notes. Only about one-sixth of the work is de-

voted to the *Passeriformes*, which nearly equal in number of species the rest of the class, only a few pages being allotted to even the larger families; and the various generic groups are mentioned, as a rule, only by their technical generic names. The book is thus evidently not really adapted to beginners, nor wholly suited to the general reader, though apparently designed 'not only for the tyro in ornithology, but also for the traveller or resident in foreign parts interested in the subject.' The woodcuts that quite fully illustrate the text are, for the most part, excellent, and prepared especially for the work by G. E. Lodge; others are familiar through frequent previous use. Considering the limitation of space imposed for the subject, the author has, perhaps, supplied all that could be rightfully expected, and has certainly shown himself to be 'up to date' in all of the essentials of his subject.

J. A. A.

Experimental Morphology. By Charles B. Davenport. New York and London, The Macmillan Company. 1899. Part Second. Pp. 228.

The second part of Davenport's Experimental Morphology that has just appeared deals entirely with phenomena of growth. The first volume described the effects of chemical and physical agents upon protoplosm, and it is intended to devote the third volume to cell-division and the fourth to differentiation. The author states that it is the aim of this series 'so to exhibit our present knowledge in the field of experimental morphology as to indicate the direction for further research.'

The present volume gives a clear, brief statement of what is known in regard to growth in plants and animals. Most of the illustrations are taken from plant physiology, and it may, therefore, be questioned whether a zoologist is in position to summarize so large and important a field of botanical research, but in justification it should be stated that Davenport has attempted to deal with the subject from a common biological standpoint.

In reading this volume one cannot fail to be impressed by the enormous difference in our knowledge of growth-phenomena in plants and animals. The subjects dealt with cover one of the most interesting fields of biological study—the responses of organisms to their surroundings and the relation of these responses to the conditions of life under which the form is living or has lived in the past. The introductory chapter is intended to give an idea of normal growth. Organic growth is defined as increase in volume—'it is not development, not differentiation and not increase in mass.' A broad definition of this sort, while convenient to include a large number of changes resulting in 'an increase in volume,' may lead to difficulties if an attempt is made to find a common explanation of all the phenomena included in the definition, for the processes that take place in plants and animals that produce an increase in volume may be entirely different in their nature. The author has skillfully avoided this pitfall in most cases, although at times one cannot but feel that a most heterogeneous collection of facts has been included in the same category.

The first chapter (XI.) deals with the effects of chemical agents on growth, and gives in compact form a large amount of useful information. In most cases the action of the substance seems to be purely physiological and only secondarily formative. It is not obvious why so much space should be given to pure plant physiology. It is, no doubt, difficult to draw the line between substances that act as foods and others that produce growth, since the latter often (but not always) depend on the former.

An admirable account of the rôle of water in growth is given in Chapter XII. Here the author has some new facts that bear on the problem. In the next chapter, dealing with the effect of density of the medium on growth, the results are summed up as showing that 'the diminution or growth is proportional to the osmotic action of the medium.' It is possible, however, that the effect is due also, in part, to the direct injurious action of the salts used to increase the density of the fluids. If due to osmotic action alone, then, the results that follow when different substances are used should be in proportion to their osmotic equivalents, but the few facts that are given do not entirely support this general conclusion.

In Chapter XIV. the effect of molar agents is

dealt with. The effects of rough shaking on bacteria and of tensions and torsions on plant tissues are described. Nothing is said in regard to the changes that take place in bones, as a result of displacement, etc. The closing of wounded surfaces (in Stentor and Hydra) is said to 'be grossly mechanical.' I may add from observations of my own that, in some cases at least (in Tubularia and in the embryo of Rana), the closing of the wound after injury cannot be explained as grossly mechanical, but is due rather to a movement of the living cells in response to a stimulus.

The action of parts of plants in response to contact and the general phenomena of bending in seedlings, etc., can scarcely be included in a definition of growth, even as broadly defined by the author, for while there is an increase in volume on one side there may be a corresponding decrease on the opposite side, the volume of the whole plant or part remaining approximately the same.

A brief account of the effect of gravity is given in Chapter XV. Two classes of effects are distinguished, the first mechanical, "due to gravity, acting on the growing organ as it might on any other heavy body. The second is a vital effect, having no immediate, direct physical relation to the cause." It seems a little obscure to state that a vital effect has 'no immediate, direct physical relation to the cause.' That the connection is a causal connection, even if a remote one, few will be bold enough to deny. The distinction that the author wishes to make is, perhaps, fairly clear, but the words may easily lead to a misconception of what is meant by vital effects. Again, on page 417 (in Chapter XVII., dealing with the effect of light upon growth), the author concludes, after showing that the eggs of many (but not all) animals are sheltered from sunlight, 'that, in general, growth does not take place in nature in full sunlight.' It is obvious that in many cases the eggs deposited in the dark are better concealed, and it is not improbable that this may account for their development in the dark. Under these conditions they would become attuned to the absence of light. The more rapid growth of plants in the dark is described in detail, the effect of colored light on the growth of animals and plants, and the direction of growth in reponse to light, are discussed at some length.

The effect of heat on growth, as well as on the direction of growth (in plants), is dealt with in Chapter XVIII. The interesting fact is pointed out that under certain conditions the bending of a plant towards the source of heat cannot be explained as the direct result of the heat causing growth on the warmer side, since the concave side is the one turned towards the source of heat. This experiment may well make one question whether or not these phenomena of bending are growth phenomena in the ordinary use of the terms.

In the concluding chapter the cooperation of several factors in normal growth is analyzed. A clear summary of the work of Semper and de Varigny on the growth of water-snails in a confined space is given. There is some excellent matter in the few pages of this chapter, although here and there one may find fault with the expression rather than with the general sense. The attunement or acclimatization of an organism to its surroundings is emphasized. A tentative hypothesis to account for the attunement is offered. This attempt to construct a possible explanation brings clearly to light that the author pictures to himself these 'vital phenomena' as chemical responses to external agents. The contrast, therefore, so often made in the text between physical and vital effects would seem to be a difference between physical and chemical reactions. If anything more than this is intended it is not included in the final attempt at an explanation, although it is stated on a preceding page that the 'specific effects' cannot at present be accounted for by known chemical processes, 'but result from peculiarities of the specific protoplasms which depend largely upon the past history of each kind of protoplasm.'

If we have taken issue with the author on a few points it is only because in these the book appears incomplete or imperfect. Taken as a whole it is a valuable addition to our text-books, and the author is to be congratulated on having performed so difficult and arduous a task with success. The careful and exact summaries that are given will be of use to those not having access to the original papers.

The book contains many tables compiled from various sources. The data are generally given in the form of curves so that a large amount of information may be comprised in a single diagram. The clear and judicial discussion of the topics makes the book a model of its kind. Especially praiseworthy is the absence of the rash speculation so predominant in biological literature of recent years.

T. H. Morgan.

Bryn Mawr College.

General Physiology. By Professor Max Verworn. Translated and edited from the second edition (1897) by Professor F. S. Lee. New York, Macmillan & Co. 1899. Pp. xvi+616. 285 figures.

The subject-matter of this book is arranged in five chapters with headings as follows: The aims and methods of physiological research, living substance, elementary vital phenomena, the conditions of life, stimuli and their action, and the mechanism of life. The English edition is very happily rendered, and is characterized by an extremely small residuum of Teutonic idioms, while the privileges of the editor have been very skillfully but sparingly exercised.

The book is chiefly concerned with the cell as such and as organism, and it seems to the writer that it hardly justifies the resounding title of 'General Physiology, or the Science of Life.' It is usually unfair to pass judgment upon the nature of a work from any single paragraph which may be required in a review, but the closing sentences of the volume are fairly indicative of the author's conception of his subject. "The cell is the element of living substance. All living substance exists in cells, and all of the functions of living substance originate in the elementary vital phenomena of cells. Hence, if the task of the physiologist lies in the explanation of vital phenomena, general physiology can be only cell-physiology." These sentences are faultlessly rhetorical, but they do not exhibit an unassailable logic, at least from the point of view of the botanist, or the physiologist interested in the general properties of organisms.

The work of investigators upon the physiology and organization of the protoplasm of plants has been somewhat more uniformly developed, and the results attained have been given a wider interpretation than similar efforts in the animal world; hence the value of this volume as a reactionary protest against the minute and profitless specializations which have absorbed so much of the energy of the animal physiologist is not so apparent to the plant physiologist. The latter feels no need for a return to investigations in cell-physiology, since his researches upon all the more important activities of vegetal protoplasm have been extended to cover material of the widest range of morphological and physiological differentiation, and have been an investigation of principles rather than a study of the functions of special tissues.

Without reference to the above, the book is a very valuable and welcome addition to the library and laboratory accessories of the plant physiologist, not for what it contains about plants, for the paragraphs devoted to these organisms are teeming with errors and omissions, or are badly antiquated, but for its comprehensive treatment of the composition and elementary activities of protoplasm, and the metabolic and directive reactions to stimuli, and the sections devoted to these subjects are well executed. The historical sketch of the development and methods of physiological research, as well as the metaphysical discussions of the conditions of life properly belong here, although they do not constitute the most valuable or striking part of the book.

It appears to the reviewer that the physiological aspects of the form and size of the cell are but scantily touched upon; that the rôle and distribution of inorganic matter in the cell does not take into account the greater mass of the available information on that subject, while secretion, absorption and election of food do not receive deserved attention. The fatuous distinction of ferments into 'organized' and 'unorganized' bodies bids fair to be immortal, since it is continued here and in many other prominent texts recently issued, although yeast, the well-worn example of the 'organized ferments,' has been found to secrete definite enzymes, as is doubtless the case with all ferment organisms. It is certainly antiquated to quote Sachs to the effect that starch is the first 'visible product' of the

activity of the chlorophyllaceous cell in the sunlight. The curvature of twining stems is not thigmotaxis (p. 443). The use of the phrase 'conduction of a stimulus' to indicate the transmission of an impulse from the point of reception of the stimulus to a reaction zone is a mistake resulting from the literal translation of 'Reizleitung.' The German word 'Reiz' having a broad meaning which permits its use to designate both the stimulus and the stimulus-effect. 'Every change in the external conditions of an organism constitutes a stimulus;' but it is to be presumed that no one would mean that these changes in the intensity of external energy, rather than the shock of such change, are transmitted by nerves or other conducting mechanisms.

Perhaps the most remarkable omission in the entire work is that which occurs in the discussion of the history of death. No attention is given to the aging or senescence of cells, and there is no mention of any example of the plant cell in the histolytic processes, or metamorphic death, although this phenomenon is of such importance that all types of plants furnish dead cells from normal atrophies and degenerations, while in the higher types the greater bulk of the plant-body is made up of dead cells.

The greater number of the faults enumerated above would be due to the inaccessibility of the botanical literature to the animal physiologist, and are of such nature that they may be easily eliminated from future editions. The book has a long period of usefulness before it. It is stimulating and suggestive, and will do much to broaden investigation upon both the animal and vegetal organism; a purpose it would accomplish equally well under its proper title of 'The Physiology of the Cell.'

D. T. MACDOUGAL.
UNIVERSITY OF MINNESOTA.

GENERAL.

THE last Legislature of the State of Arkansas provided for the printing of the hitherto unpublished reports of Dr. J. C. Branner, formerly State Geologist of that State. There are five volumes of these reports, viz: (1) Coal; (2) Lower Coal Measures; (3) Clays, Kaolins and Bauxites; (4) Zinc and Lead; (5) Report on the general geology of the State. Provisions were also made for printing new editions of the reports already out.

THE sixth volume of Biological Lectures from the Wood's Holl Laboratory, in the press of Messrs. Ginn & Co., will contain:

'The Structure of Protoplasm,' E. B. Wilson.

'Cell-Lineage and Ancestral Reminiscence,' E. B. Wilson.

'Adaptation in Cleavage,' Frank R. Lillie.

'Protoplasmic Movement as a Factor of Differentiation,' Edwin G. Conklin.

'Equal and Unequal Cleavage,' A. L. Treadwell.

'Cell Origin of the Prototroch,' A. D. Mead.

'Relation of the Axis of the Embryo to the First Cleavage Plane,' Cornelia M. Clapp.

'Observations on Various Nucleolar Structures of the Cell,' Thomas H. Montgomery, Jr.

'Protoplasmic Contractility and Phosphorescence,' S. Watasé.

'Some Problems of Regeneration,' T. H. Morgan.

'The Elimination of the Unfit,' H. C. Bumpus.

'Heredity of Coloration in Fishes,' Jacques Loeb.

'Do the Reactions of Lower Animals, Due to Injury, Indicate Pain Sensations,' W. W. Norman.

'North American Ruminant-like Animals,' W. B. Scott.

'Caspar Friedrich Wolff and the Theoria Generationis,' W. M. Wheeler.

'Animal Behavior,' C. O. Whitman.

MM. GEORGES CARRÉ and C. Naud have begun the publication of a series of scientific monographs under the editorial direction of leading French men of science. MM. Appell, Cornu, d'Arsonval, Friedel, Lippmann, Moissan, Poincaré and Potter are responsible for the physical and mathematical sciences and MM. Balbiani, d'Arsonval, Filhol, Fouqué, Gaudry, Guignard, Marey and Milne-Edwards for the biological sciences. The numbers so far issued are as follows: 'Les Oscillations Électriques,' by M. Poincaré; 'La Specificite Cellulaire,' by M. Bard; 'La Sexualité,' by M. le Dantec.

SCIENTIFIC JOURNALS AND ARTICLES.

THE papers in the *American Journal of Science* for May are as follows:

'Some Experiments with Endothermic Gases,' by W. G. Mixter.

'Hypothesis to explain the partial non-explosive Combination of Explosive Gases and Gaseous Mixtures,' by W. G. Mixter.

'Occurrence of Paleotrochis in Volcanic Rocks in Mexico,' by H. S. Williams.

'Origin of Paleotrochis,' by J. S. Diller.

'Association of Argillaceous Rocks with Quartz Veins in the Region of Diamantina, Brazil,' by O. A. Derby.

Goldschmidtite, a New Mineral,' by W. H. Hobbs; 'Hydromica from New Jersey,' by F. W. Clarke and N. H. Darton.

'Powellite Crystals from Michigan,' by C. Palache.

'Volatilization of the Iron Chlorides in Analysis, and the Separation of the Oxides of Iron and Aluminum,' by F. A. Gooch and F. S. Havens.

'Descriptions of imperfectly known and new Actinians, with Critical Notes on other Species, V,' by A. E. Verrill.

'Preliminary Note as to the Cause of Root-Pressure,' by R. G. Leavitt.

'Study of some American Fossil Cycads, Part III.,' by G. R. Wieland.

Professor L. V. Pirsson, who holds the chair of geology in the Sheffield Scientific School of Yale University, has become an associate editor of the *Journal* in the place of the late Professor Marsh.

After the close of the current volume, in April, the *Zoological Bulletin*, edited by Professors Whitman and Wheeler, of the University of Chicago and published by Messrs. Ginn & Co., will be continued under the title the *Biological Bulletin* and be published under the auspices of the Marine Biological Laboratory. The scope of the *Bulletin* will be enlarged so as to include General Biology, Physiology and Botany. It will further include occasional reviews and reports of work and lectures at the Laboratory. The *Bulletin* will be open, as heretofore, to scientific contributions from any source.

SOCIETIES AND ACADEMIES.

THE PHILOSOPHICAL SOCIETY OF WASHINGTON.

The 500th meeting of the Society was celebrated on April 15th by a dinner at Rauscher's. About fifty members were present. After coffee had been served, the President, Mr. O. H. Tittmann, in his usual felicitous manner, called on the past Presidents of the Society who had honored the banquet by their presence. Seven were present, namely, Newcomb, Harkness, Eastman, Dall, Clarke, Baker and Bigelow. Interesting remarks were made by each of these gentlemen, on the past history of the Society, its relation to present scientific progress, and its future sphere of usefulness. Informal intercourse was had for a short time after adjournment.

E. D. Preston,
Secretary.

ENTOMOLOGICAL SOCIETY OF WASHINGTON, APRIL 18, 1899.

Under the head of Exhibition of Specimens and Short Notes, Mr. Howard exhibited a vial full of specimens of a species of a *Peripatus* just received from some unknown correspondent in Trinidad.

Mr. Schwarz showed a specimen of *Chrysina erubescens* Bates. The determination he said was somewhat doubtful, but probably correct. The species is a distinct Central American form, but the specimens showed were found in Madera Canyon, south Arizona. The insect is probably a grape feeder.

Dr. Dyar showed specimens of *Megalopyge krugii*, Dew., collected by Mr. Busck in Porto Rico. The larva was described by Dewitz in his original communication, but so briefly that additional points were mentioned.

Mr. Howard asked whether Mr. Busck had been stung by this larva, and Mr. Busck replied that the first one which he found had fallen on the back of his hand and produced severe pain and inflammation which lasted for three days.

The first paper of the evening was read by Mr. Schwarz and consisted of a continuation of the Hubbard correspondence from the Southwest. The letter read at this meeting contained a discussion of the insect fauna of *Dasylirion wheeleri*. In discussion Mr. Pollard asked whether the agave and other large plants of that region have similar insect fauna. Mr. Schwarz replied that the agave is the only liliaceous plant of that region which has an insect enemy which attacks it when healthy. This is a lepidopterous larva of the genus *Megathymus*. The communication was briefly discussed by Messrs. Cockerell and Ashmead, Mr. Cockerell stating that two Coccids had been found upon the *Dasylirion*, but that both species

were also found upon yuccas. Mr. Ashmead said that the *Dasylirion* insects were very similar in character to the insects found in decaying palmetto in Florida.

The next paper was by Mr. Marlatt, and in the absence of the author was read by Mr. Benton. It was entitled 'Remarks on some recent work on Coccidæ.'

L. O. HOWARD,
Secretary.

THE WASHINGTON BOTANICAL CLUB.

THE fifth regular meeting of the Washington Botanical Club was held April 5, 1899, at the residence of Mr. Frederick V. Coville.

Professor E. L. Greene made some remarks on the occurrence of parthenogenesis in *Antennaria*, apropos of Juel's recently published investigations in *A. alpina*. He considered the phenomenon to be well established in several of our native species.

Mr. J. G. Smith presented a synopsis of a proposed revision of the genus *Sitanion*, a group of grasses long included under *Elymus*. He was able to segregate a large number of new species, chiefly from Western localities.

Mr. H. J. Webber gave some notes on the various forms of *Zamia* found in Florida. There are apparently two well-marked species, at least on the east coast, one confined to the northern, the other to the southern half of the State, while on the west coast occurs possibly a third. Neither of these species is referable to *Z. integrifolia* Jacq., a name under which the plants have been described in most text-books. Mr. Webber exhibited numerous photographs, pointing out remarkable differences in the shape and structure of the fertile spike.

The Club extended invitations to the Philadelphia Botanical Club and to the Torrey Botanical Club of New York to visit Washington for a series of botanical excursions during the last week in May.

CHARLES LOUIS POLLARD,
Secretary.

SECTION OF ASTRONOMY AND PHYSICS OF THE NEW YORK ACADEMY OF SCIENCES.

A MEETING of the Section was held on April 10th, Professor M. I. Pupin, the Chairman of the Section, presiding.

A paper was read by Dr. A. S. Chessin on 'The Temperature of Gaseous Celestial Bodies.' The author said, in brief, that, in view of some extravagant and baseless assertions which have appeared lately in both scientific and popular periodicals with regard to certain supposed laws of temperature in gaseous celestial bodies, it seemed proper to state the true condition of our knowledge in this direction. Dr. Chessin showed that what Dr. See assumed, in a recent article, to be a 'fundamental law' of nature, namely, the formula $RT = a$ constant, in which $T =$ the absolute temperature of the gaseous body and $R =$ the radius, was neither a 'fundamental' nor 'any law' at all; in fact, the formula is the result of erroneous and superficial calculations. Dr. Chessin also gave an account of the work done by others on the question of the temperature of heavenly bodies, particularly referring to the investigations of A. Ritter, in Wiedemann's Annalen for 1878. He showed how far from applicable to actual facts most of these theoretical discussions and calculations are, and he drew the conclusion that at this stage of our knowledge it would be but an idle speculation to formulate any law which may govern the changes of temperature in heavenly bodies. He called attention to one interesting case discussed by Ritter in his theoretical investigations, a case in which when γ, or the ratio of the specific heat at constant pressure to that at constant volume, is greater than 4/3, we could have a pulsating condition of the gaseous body about a condition of equilibrium. A *résumé* of Ritter's work appears in Exner's Repertorium for 1884. Betti, of Pisa, has discussed the same problems and obtained the same results.

In the discussion Professor Pupin said that in the contraction of a heavenly body the work done by gravitation might be an excessively small fraction of the total work done by all the forces, including the so-called forces of chemical affinity, which we usually consider are due to electrical forces. But we cannot at present base any calculations on these, as we know so little about them.

Professor Rees said that if astronomers cannot yet solve these problems, it is because they cannot get the proper knowledge from the physicists on the physical parts of the question.

Mr. W. C. Kretz read a paper on the 'Positions and Proper Motions of Stars in Coma Berenices from Rutherfurd Photographs.' Rutherfurd took fourteen photographs in the years 1870, 1875 and 1876 of the cluster in Coma Berenices. The positions of these stars on the plates were measured with a Repsold measuring machine, and the reduction was made by the method worked out by Professor Jacoby. Great precautions were taken to eliminate all possible errors. The positions obtained were compared with those obtained by Chase with the Yale heliometer in 1892. In this manner a catalogue of the positions and proper motions of twenty-four stars was obtained, which was the object of the research.

Wm. S. Day,
Secretary.

THE NEW YORK SECTION OF THE AMERICAN CHEMICAL SOCIETY.

The regular monthly meeting of the New York Section of the American Chemical Society was held at the Chemists' Club, 108 West Fifty-fifth street on Friday evening, April the 7th; Dr. Wm. McMurtrie presiding, and about sixty-five members present.

The following papers were read: 'The Toxic Action of Sodium Fluoride,' by H. B. Baldwin. 'The Chemistry of the By-Products of Coke Ovens,' J. D. Pennock. 'Notes on the Chemistry of the Carbides,' J. A. Matthews. 'The Distribution of Alkali in Montana,' F. W. Traphagen and W. M. Cobleigh; read by Mr. Cobleigh.

Mr. Baldwin said that, owing to the now somewhat extended use of sodium fluoride in the arts and as a preservative and insecticide, there is considerable liability of accidental poisoning from the substance. Several cases are cited with the symptoms observed, the most prominent of which are nausea and vomiting within a few minutes. One case resulted fatally from an unknown dose, probably about ten grams. Five grams produced serious results in another case. The author took several experimental doses and was made ill by 0.25 gram. A case is also cited where about 50 grams were taken with complete recovery. The literature of the substance as a toxic agent is very meagre, but experiments have been made by several German and French investigators. Shultz found that by subcutaneous injection the lethal dose per kilogram of body weight was for rabbits 0.2–0.4 gram, for dogs 0.3 gram and for frogs 0.005–0.006 gram. Sodium fluoride should be classed among the less violent poisons and ought to find a place in works on toxicology.

The paper of Messrs. Traphagen and Cobleigh was an interesting description of the distribution of alkali in Montana with analytical data.

Professor Matthews gave a classification of the carbides thus far known, according to their methods of preparation and properties, and described their commercial development, beginning with carborundum, of which in 1895 the production was about 300 pounds per diem. Last July the daily output was 4,300 pounds and over. It is said to be harder than emery and lighter. It has been successfully used in plate-glass grinding, as well as for all ordinary purposes. Recently it has been put to an entirely new use, that of furnishing silicon to steel, being a substitute for ferro-silicon where the addition of some carbon is not objectionable.

The calcium carbide industry was also reviewed, and several uses other than for preparation of acetylene were mentioned, as follows: Drying alcohol and other organic liquids, absolute alcohol being easily prepared by its use; to deoxidize and carbonize iron, and as a reducing agent in fire assays. Moissan has used it as a reducing agent in the preparation of other carbides.

Mr. Pennock's paper gave interesting particulars out of the construction of the coke ovens at Syracuse, N. Y., with details of the percentages of bye-products, composition of the gas, tar, etc., closing with lantern views of the exterior and interior of the buildings, showing the retorts and other important parts of the plant.

Durand Woodman,
Secretary.

DISCUSSION AND CORRESPONDENCE.

MESSRS. LEHMANN AND HANSEN ON TELEPATHY.

To the Editor of Science: One or two of your readers may possibly remember a small exchange of words between Professor

Titchener and myself *apropos* of his article in SCIENCE for December 23d (Vol. VIII., p. 897).

Messrs. Lehmann and Hansen had sought to show experimentally that the results of certain experiments by Professor H. Sidgwick, which the latter had ascribed to 'thought-transference,' were really due to involuntary whispering by the agent, overheard hyperæsthetically by the subjects. Professor Titchener closed his article by saying: "The brilliant work of Messrs. L. and H. has probably done more for scientific psychology than could have been accomplished by any aloofness, however authoritative."

To these words I, in your next number, took exception, saying that if Professor Titchener would read Sidgwick's and my criticisms of the work of the Danish investigators, he would probably agree 'that, owing to the fewness of the data which they had collected, they entirely failed to prove their point.' I, consequently, called their essay 'an exploded document'; to which my 'scientifically-minded' *confrère* rejoined (in SCIENCE for January 6th) that he had carefully read the criticisms, and had thus seen us 'handling the fuse,' but that he had 'not yet heard the detonation.'

As the explosion was so audible to me, the disproof being quasi-mathematical, I was astounded at this hardness of hearing in my colleague; and, to make sure that I was not a victim of auditory hallucination, I wrote to Professor Lehmann to know what he himself thought of his conclusions, in the light of the criticisms in question. His answer, somewhat belated, just arrives.

He says: "Your own as well as Professor Sidgwick's experiments and computations prove, beyond a doubt, that the play of chance had thrown into my hands a result distinctly too favorable to my theory, and that the said theory is consequently not yet established (*bewiesen*)."

This is identically Professor Sidgwick's and my contention; and for his candor, as well as for his willingness to take pains to experiment in this region, Professor Lehmann deserves to stand high as a 'psychical researcher.'

Professor Titchener, meanwhile, still hugging the exploded document, wanders upon what he calls 'the straight scientific path,' having it apparently all to himself. May the consciousness of his fidelity to correct scientist principles console him in some degree both for his deafness and for his isolation.

WILLIAM JAMES.

CAMBRIDGE, April 20, 1899.

TWO CORRECTIONS.

MY attention has just been called to this paragraph in SCIENCE, June 3, 1898, p. 784, foot of column two:

"*Erratum:* In the review of Wilder's System of Nomenclature, p. 716, col. I, line 5, for 'chippocamp' read 'hippocamp.'"

This prompt public correction renders needless and unjust the commentary upon the subject in my address last December before the Association of American Anatomists (*Proceedings*, p. 33, and SCIENCE, April 21, 1899, p. 577), and I deplore my non-acquaintance with it up to the present time. Since none of those who heard my address reminded me of the 'Erratum,' it seems to have been overlooked by them also.

In this connection may properly be corrected a typographical error in the address itself (*Proceedings*, p. 16, and SCIENCE, April 21, 1899, p. 566, note, title 6); the date of publication of the 'Review' in SCIENCE should be May 20th, not 28th.

These corrections will be incorporated in the *Proceedings* and sent to those who receive copies of SCIENCE from me.

B. G. WILDER.

ITHACA, N. Y., April 26, 1899.

[It may be explained the typographical error referred to above was not due to any oversight on the part of the writer of the review. An inverted comma (') was inserted in the proof before hippocamp, which was mistaken by the printer and the proof reader for a *c.*—ED. SCIENCE.]

NOTES ON PHYSICS.

A NEW THEORY OF THE ZEEMAN EFFECT.

DURING the last eight or ten years Goldhammer has published at intervals in *Wiedemann's Annalen* a series of papers dealing with the electro-magnetic theory of light, and espe-

cially upon the transmission of light through ordinary media. The chief difference between his treatment of the subject and the classical one of Maxwell lies in the fact that Goldhammer considers what are usually called the *constants* of the medium, the specific resistance or the dielectric constant, for instance, not to be *constants*, but to be *functions of the wave frequency, developable in power series.* It may be remarked that this view receives a certain amount of support from the researches of Blondlot and J. J. Thomson, which show that the dielectric constants of certain materials do depend upon the frequency.

Developing mathematically the preceding hypothesis, Goldhammer arrives at very general equations for the velocity and absorption of light in a given medium. It is worthy of remark that the formulas given by Helmholtz, Sellmeier and Lommel can all be considered as special cases of that of Goldhammer and can be derived from it.

In *Wied. Ann.*, No. 3, Band 67, Goldhammer applies the theory which has just been sketched to the Zeeman effect, and thus obtains a new theoretical explanation of the phenomenon. Considering the absorption spectra first, he shows that any alteration in the specific constants of the medium will cause a change in the position of the absorption lines. He then assumes that the magnetic field does cause such an alteration in these quantities; in support of this assumption, he calls attention to a paper by Bolzmann (*Wied. Ann.*, 31, p. 789), in which it is shown that a magnetic field increases the resistance of a gas placed in it.

Kirchoff's laws allow one to pass from the absorption spectrum to that of emission. Then in a bright-line spectrum the effect of a magnetic field is to cause displacements in the lines and might give rise to doublets and triplets.

In order to account for the polarization phenomena, Goldhammer makes a further assumption that the magnetic field causes the medium to become æleotropic and double-refracting. The circular polarization of the doublets, when viewed along the lines of force, is very closely connected with the well-known magnetic rotation of the plane of polarization.

It will be noticed that this theory of Goldhammer's differs materially from those proposed by Lorentz and Larmor. Goldhammer makes the whole of the phenomena depend upon changes in the medium, while Lorentz and Larmor attribute them to the electrodynamic forces developed by the motion of electrified ions in a magnetic field.

At present it seems that the ionic is the more promising of the two theories, since it gives an explanation, incomplete it is true, of the complexity of structure of the lines and of their polarization. The numerical value of the ratio between the mass of a vibrating ion and the charge carried by it as derived from the Zeeman effect is in good agreement with that obtained by J. J. Thomson from the phenomena of cathode rays.

DAYLIGHT-PHOSPHORESCENCE.

Mourelo (*Comptes Rendus*, t. CXXVIII., p. 557) has made the curious discovery that sulphides of strontium, calcium, barium and zinc, prepared in a particular way, show much more brilliant phosphorescence after exposure to diffused daylight than they do after exposure to direct sunlight, and, further, that periodic exposure to diffused daylight increases very remarkably the power of phosphorescing. After being brought to this sensitive state one phosphorescing portion is able to excite phosphorescence in another non-luminous portion either when the two portions are in contact or when they are contained in separate glass tubes.

A. St.C. D.

NOTES ON INORGANIC CHEMISTRY.

An analysis of the water of the Great, or Illecilliwaet Glacier, British Columbia, has been published in the *Chemical News* by F. T. Shutt and A. T. Charron. The waters were taken a few feet from the face of the glacier, and were of characteristic turbid or milky appearance. Analysis showed water of great organic purity, the free ammonia being 0.018 parts per million; albumenoid ammonia 0.027 to 0.037; nitrogen as nitrates and nitrites 0.0246 to 0.0442; chlorin 0.1; solids 12 to 30.8. On sedimentation the waters became perfectly clear, and microscopic examination of the deposit showed

it to be very fine rock matter, chiefly fragments of quartzite.

AN analysis of an artesian water from Derbyshire is given by John White in the *Analyst*, which is peculiar as containing barium, it being the first recorded occurrence of this metal in waters in this section. The well is 1,300 feet deep and 160 feet above the sea level. According to the analysis given, the water first obtained at depth of 837 feet, contained of barium carbonate 1.77 parts per 100,000; the deep water contained at first of barium chlorid 38.55 parts, and six months later 40.7; water eighty feet below the surface contained 3.03 parts. The sodium chlorid in the deep water was over two thousand parts. The author discusses the origin of the barium salt. Clowes has found minute crystals of barium sulfate in the red sandstone near Nottingham, and Dieulafait has shown barium to be a constant constituent of primitive rocks, but this does not explain the conversion of the sulfate into carbonate or chlorid. The only possible explanation, according to the author, is that the barium sulfate has been at high temperature reduced to the sulfid by coal, and this converted into the chlorid by concentrated salt solution. The carbonate is derived from the chlorid. In confirmation of this it is pointed out that barium sulfate has been found in connection with coal deposits and barium chlorid in water in the vicinity of coal mines. It is, however, not impossible that under certain conditions, such as Melikoff has shown take place between sodium sulfate or sodium chlorid and calcium carbonate in the presence of aluminum or ferric hydroxid, a reaction may take place between the barium sulfate and sodium chlorid in a concentrated solution of the latter.

PROFESSOR VÈZES, of Bordeaux, has continued his work upon the oxalates and nitrites of the platinum metals, and his last contribution to the *Bulletin Société Chimique* is on the complex salts of palladium. A concentrated solution of potassium chloropalladite is converted by potassium oxalate into the pallado-oxalate, and the same salt is formed by the action of oxalic acid upon the pallado-nitrite. On the other hand, the pallado-oxalate is readily converted into the chloropalladite by hydrochloric acid, and into the pallado-nitrate by potassium nitrate. These reactions correspond very closely to those of the platinum salts as investigated by Vèzes, except that only one modification of the pallado-oxalate has been found. The pallado-oxalic acid was also obtained and found to be tolerably stable.

The same journal contains analyses of a series of potassium, ammonium and silver salts of the so-called osmiamic acid, by Brizard, in which the formula proposed by Joly for this acid is fully confirmed. According to this, osmiamic acid is a nitroso compound, having the formula $OsO(NO)OH$, and corresponds to nitroso hydroxid of ruthenium.

J. L. H.

CURRENT NOTES ON METEOROLOGY.

BLUE HILL OBSERVATORY BULLETINS.

BULLETIN No. 2 (1899) of Blue Hill Observatory, prepared by A. E. Sweetland, contains accounts of two remarkable snow storms which occurred during the past winter. The first storm, that of November 26–27, 1898, caused the wreck of 141 vessels on the New England coast, and the loss of 280 lives. It was during this storm that the steamer *Portland*, with about 175 persons on board, was lost off Cape Cod. The suddenness and violence of this storm were due to the rapid increase in energy which took place when a cyclone from the Gulf of Mexico and one from the Great Lakes met on the coast. The fall of snow was very heavy. On February 8–14, 1899, a severe cold wave and another heavy snowfall occurred. On February 13th, at 8 a. m., the zero isotherm extended as far south as latitude 31°. At Blue Hill the average temperature of the five days February 8–13 was 3.1° lower than the average of any successive five days since the Observatory was established. This cold wave was followed by a heavy snow storm, with high winds, along the North Atlantic coast. It is interesting to note that the preceding cold wave, although it caused much suffering by its severity at the time, had one very fortunate effect. The extreme cold which had almost closed some of the harbors with ice, and the difficulty of navigation when the waves, driven by the strong westerly gale, quickly

froze on decks and rigging, had resulted in keeping many vessels in port. In consequence, but few lives were lost at sea.

Bulletin No. 3, by S. P. Fergusson, is entitled *Progress of Experiments with Kites during 1897–98 at Blue Hill Observatory*, and presents an admirable summary of this work. Both Bulletins are abundantly illustrated.

SNOW ROLLERS.

THE March number of *Climate and Crops: New England Section* notes the occurrence of 'Snow Rollers' at Grafton, N. H., on March 16th, last. This is an interesting but comparatively rare phenomenon, occasionally observed in the winter season when freshly fallen snow is rolled into balls or cylinders by the wind. At Grafton these are stated to have been rolled up in countless numbers. Some of the rollers were as large as a barrel, and the fields and hills were covered with them. Other occurrences of the same phenomenon have been noted, within recent years, at Spokane, Wash., in December, 1895; at Hartford, Conn., on February 19, 1896, and in Saline county, Kan., on January 14, 1898. At Spokane there were 'hundreds of snow cylinders of uniform size, and as perfectly formed as though they had been cast in a mould.' The rollers were from 12 to 16 inches long, and from 6 to 10 inches in diameter. At Hartford some of the rollers measured 8 inches in diameter. In the Kansas case the size varied from that of base-balls to that of half-a-bushel measures. The uniform size, often noted, may be explained by the fact that the wind rolls the cylinders of snow along the ground until they become too heavy to be moved farther. If the velocity of the wind continues about the same it is likely, other things being equal, that the rollers will have about the same size.

A COURSE IN METEOROLOGY AT OHIO STATE UNIVERSITY.

IT is a pleasure to note the establishment of a new course in meteorology at the Ohio State University, Columbus, Ohio. This course, which is being given by Mr. J. Warren Smith, Section Director of the U. S. Weather Bureau at Columbus, is required in the junior year in the course in agriculture and horticulture, and is elective in the courses in arts, philosophy and science. It is also open to all teachers. Lectures began on March 29th, and are given twice a week during a term of ten weeks. The object of the course, as stated in the prospectus, is 'to open and outline a rational and systematic line of study of the leading facts concerning our atmosphere, and of the methods of observing and investigating the daily weather changes, and of the physical laws underlying these changes.' Davis's 'Elementary Meteorology' is used as a text-book. The lectures are illustrated by means of lantern views, and the 'laboratory work' includes the use of the ordinary instruments and practice in the construction of weather maps.

CLIMATE OF THE CONGO FREE STATE.

THERE has recently been published an admirable little pamphlet on the climate of the Congo Free State, by M. Lancaster, Director of the Meteorological Service of Belgium (*Court Aperçu du Climat du Congo*, 12mo., Brussels, 1899, pp. 43). This is a summary, in a very convenient form, of the meteorological portion of the volume on the climate, soils and hygiene of the Congo Free State, noticed in SCIENCE for January 13, 1899, p. 72, and is reprinted from the *Annuaire de l'Observatoire royal de Belgique pour* 1899.

R. DEC. WARD.

HARVARD UNIVERSITY

A NEW MARINE BIOLOGICAL LABORATORY.

AMERICAN biologists will doubtless be gratified to learn that the United States Fish Commission will maintain a marine biological laboratory at Beaufort, N. C., during the coming summer, and will probably undertake to establish a permanent laboratory at that place. The station will be fully equipped for a limited number of investigators and be ready for occupancy by June 1st. There will be one building devoted to laboratory purposes and another affording sleeping accommodations.

Dr. H. V. Wilson, professor of biology in the University of North Carolina, has been asked to become the director of the laboratory. Dr. Wilson was associated with the Commission at its Woods Holl laboratory for several years

and needs no introduction to the scientific world.

Beaufort is situated near one of the great ocean inlets, and the waters of the harbor and adjacent sounds are remarkably well supplied with fishes and invertebrates. The advantages this locality affords for biological research are well known, as many naturalists have from time to time resorted thereto for the study of special problems.

In the early fall Beaufort will be made the headquarters of the steamer *Fish-Hawk* during a biological and topographical survey of the oyster grounds of the State which the Commission will conduct at the request of Professor J. A. Holmes, director of the North Carolina Natural History and Geological Survey, and other State officials.

HUGH M. SMITH.

U. S. COMMISSION OF FISH AND FISHERIES.

THEORY OF THE STEAM ENGINE.

M. NADAL, in a very extended review of the recognized 'Principles of the Mathematical Theory of the Steam Engine,' in recent issues of the *Revue de Mécanique*, discusses the theory of heat-exchanges between working fluid and cylinder-walls, the influence of the duration of the admission period, that of the compression and of the velocity of operation of the motor; touching upon the experimental work of Dwelshauvers-Dery. His principal conclusions are the following:*

1. The absorptive power of the metal in contact with the vapor is finite, and variable as a function of time. It is more considerable than the emissive power. The variation of this absorbing power is a function of the amount of liquid deposited upon the wall, and that amount has been shown by Donkin to vary, in the cases reported by him, from 20 calories per square meter per unit difference of temperature between metal and vapor, per second, and, at the time of admission, down to 12 during expansion and lower, and to 2 during the period of re evaporation and of emission, and to even less values as exhaust becomes complete; although this re-evaporation may be exceedingly rapid at the moment of opening the eduction port.

2. In the case of the unjacketed cylinder the mean temperature of the wall is equal or superior to that of the vapor in contact with it.

3. The heat surrendered by the vapor at induction increases less rapidly than does the period of action, that of induction. The indications are that the range of temperature during expansion mainly affects the quantity of the heat-exchange and that the total temperature-range does not measure the waste, which is contrary to general opinion among engineers and physicists.

4. Compression in the clearance or 'dead spaces' is not always advantageous.

M. Nadal shows that the moisture on the wall plays an important part, augmenting the quantity of heat-waste as superheating diminishes it. It is found that the variation of the magnitude of heat-exchanges during the forward and the return stroke accounts largely for the well-established, and often large, gains due to the use of the steam-jacket; since that accessory may communicate heat rapidly and effectively during the earlier portion of the cycle, while the sluggish transfer of heat out of the cylinder wall during the period of low pressure and temperature checks the wastes that would otherwise then occur, and more extensively than in the earlier period. Thus this variation of transferring power of the wall acts as a sort of 'check-valve' for the heat received from the jacket, permitting it to act efficiently, where most needed and preventing loss of heat where its transfer could do no good and would be purely a waste. Thus the jacket, also, is most economical in those engines which would be most economical without it, those in which the interior walls of the cylinder are dry during exhaust.

R. H. THURSTON.

* Revue de Mécanique, 1898–9.

THE PHILADELPHIA EXPOSITION OF 1900.

WE have received from the officers of the Philadelphia Exposition of 1900 details in regard to their plans. It is their purpose to exhibit every kind of manufactured products of the United States especially suitable for export. Such exhibits will form the principal depart-

ment of the Exposition and will comprise everything which is, can or might be exported, from locomotives and heavy machinery to the smallest novelties.

There will also be a department of foreign manufactured goods, but it will not contain a single exhibit shown by a foreign manufacturer. This department will consist of collections of samples of goods made in the commercial countries of Europe and successfully sold in all foreign markets in competition with American goods and in foreign markets in which American trade has not yet been developed. These samples will be exhibited side by side with American products of the same class, and will show our manufacturers just what competition they must meet abroad, as well as the peculiarities in the demands of every foreign market.

A third department of the Exposition will show how American goods must be packed, labeled and shipped in order to meet the requirements of foreign trade, which vary according to the degree of development or civilization in each country of the world.

In October a Commercial Congress will be held in Philadelphia in connection with the meeting of the International Advisory Board of the Philadelphia Commercial Museums. There is every reason to believe that at least 800 representatives of foreign firms will be present at the sessions of the Commercial Congress and in attendance on the Exposition, in addition to the official delegates and those representing commercial organizations.

The Exposition will be under the joint auspices of the Philadelphia Commercial Museums and the Franklin Institute. Sanction and support has been given to the Exposition by the National Government, Congress appropriating $350,000 to aid it. The City of Philadelphia has given $200,000, and the State of Pennsylvania $50,000, and $100,000 is being raised in Philadelphia by individual subscriptions.

The main buildings, which are now under construction, cover eight acres of ground, and the available exhibition space will be at least 200,000 square feet Outside of the space occupied by the main buildings there will be within the Exposition grounds, which comprise a tract of fifty-six acres of land on the bank of the Schuylkill River, within fifteen minutes' ride of the City Hall, ample space for the erection of detached structures for special exhibits.

SCIENTIFIC NOTES AND NEWS.

Vice-President Branner, of Stanford University, will conduct an expedition to Brazil during the summer to work upon the geology of the stone and coral reefs of the coast. These reefs, more or less broken, extend from Ceará to the Abrolhos, a distance of more than a thousand miles. Dr. Branner did much work upon these reefs while he was connected with the Geological Survey of Brazil, but the field observations were never finished and the results of the work were not published. He hopes to complete his work during the summer vacation. The expenses of the expedition will be paid chiefly by Professor Alexander Agassiz, and the results will be published by the Museum of Comparative Zoology at Harvard.

Princeton proposes to send a small party to observe the total eclipse of the sun which is to occur on May 27, 1900. A friend of the University has provided the necessary funds, and the special apparatus that will be needed is already being constructed. The station to be occupied is not yet finally selected, but will probably be near the boundary between North and South Carolina, where it is crossed by the track of the moon's shadow, running northeastward from New Orleans to Norfolk, Va.

The Iron and Steel Institute of Great Britain has conferred the Bessemer Gold Medal for 1899 on Queen Victoria in commemoration of the great progress made in the iron and steel industries during her Majesty's reign.

The Academy of Sciences at Haile has elected Dr. Hans Lenck, professor of mineralogy at Erlangen, to membership.

Sir James Wright, C.B., late Engineer-in-Chief of the British Navy, to whom many of the improvements in British warships are due, died on April 16th in his 86th year.

The death is also announced of Sir William Roberts, F.R.S., the eminent London physician,

at the age of 69 years. He gave the Goulstonian, Lumleian and Croonian lectures and the Harveian oration before the Royal College of Physicians, and contributed in many ways to the advancement of medical science and education.

WE regret also to record the deaths of Professor Karl Scheibler, the chemist at Berlin, aged 72 years; of Dr. Josef Wastler, docent in geodesy in the Technical Institute at Graz, and of Dr. H. A. Wahlforso, professor of chemistry at Helsingfors, at the age of 60 years.

A CABLEGRAM from Constantinople states that in order to develop the agricultural resources of the empire, the Sultan has consulted with the United States Minister, Mr. O. S. Straus, in regard to securing the services of two American agricultural experts, who will be attached to the Ministry of Mines, Agriculture and Forests.

MR. JOHN HAMILTON has been appointed Secretary of Agriculture for the State of Pennsylvania by Governor Stone in the place of Mr. Thomas J. Edge, who has been compelled to resign. It is said that this change has been made for political rather than for scientific reasons.

A CIVIL SERVICE examination for the position of Computer in the Division of Forestry, Department of Agriculture, at a salary of $1,000 per annum, will be held on May 16th and 17th. The examination is chiefly on computation in forestry.

AT the annual meeting of the California Academy of Sciences officers and trustees have been elected to fill the various offices in the Academy for the ensuing year as follows: President, Willam E. Ritter; First Vice-President, Chas. H. Gilbert; Second Vice-President, H. H. Behr; Corresponding Secretary, J. O'B. Gunn; Recording Secretary, G. P. Rixford; Treasurer, L. H. Foote; Librarian, Louis Falkenau; Director of the Museum, Charles A. Keeler; Trustees, William M. Pierson, George C. Perkins, C. E. Grunsky, William H. Crocker, George W. Dickie, E. J. Molera, James F. Houghton. The yearly report of the President, William E. Ritter, showed the past year to have been one of earnest activity in the various working departments. The necessity is urged of concentrating the efforts and the funds of the Academy toward making complete the natural history collections of the State. Especial stress is laid upon the desirability of exploring the waters of the Pacific that wash the California coast, and collecting into the storecases and exhibition galleries of the Museum the scientific treasures of these waters. The report mentions the gratifying commendation which the improved style in which the *Proceedings* are issued calls forth from both at home and abroad. Here may be mentioned the highly appreciated gift of $1,000 given to the publication fund by Mr. C. P. Huntington. The report of the Librarian gives the number of volumes in the library as nearly 10,000. The crowded meetings held twice each month evince the public interest in the popular scientific lectures, which are open to all. The principal event of the year was the definite movement, appropriately initiated by the Society of California Pioneers and heartily participated in by the Academy, to secure from the State Legislalature funds for the erection of a statue to the late James Lick, to whom the Academy owes an ever-growing debt of gratitude for his beneficent gift to the institution.

THE fourteenth annual meeting of the Association of American Physicians will be held at the Arlington Hotel, Washington, D. C., on May 2d, 3d and 4th.

THE annual meeting of the Iron and Steel Institute of Great Britain will be held on May 4th and 5th. Sir William Roberts-Austen, the President-elect, will give an inaugural address, and a program has been arranged that includes papers by representatives from the United States, Austria, Russia, Spain and Sweden.

THE Council of the Royal College of Surgeons has decided to celebrate the centenary of its foundation between March 22 and June 30, 1900. The College is also considering the advisability of applying for power to grant at the time diplomas of honorary fellowships, of which not more than fifty shall be conferred.

PLANS are being made for the establishment of an institute of bacteriology and experimental medicine at Bucharest.

THE Prince of Monaco is building at Monaco a Museum of Oceanography to contain the col-

lections made by the expeditions of the yacht *Princess Alice*. It will contain not only exhibition rooms, but also laboratories for the use of men of science who wish to work upon the collections. The Museum will, in addition, represent the relations of meteorology to navigation.

The conferences established three years since by Professor Milne-Edwards for the instruction of explorers and travelers have been resumed in the Paris Museum of Natural History. A number of the professors of the Museum take part, explaining the methods of collecting and preserving plants, animals, etc., of making maps and photographs, hygienic precautions, etc.

The *Critic* of May publishes, over the name of Professor O. C. Marsh, the portrait of Professor F. A. March, of Lafayette College, the eminent philologist. The account of the late Professor Marsh accompanying the portrait opens as follows: "This excellent portrait of the distinguished paleontologist, whose unpaid service at Yale College did so much to strengthen the position of that University in the educational world, was made in this city only about a year ago. Professor Marsh himself was greatly pleased with it."

At the last monthly general meeting of the Zoological Society, London, Lieutenant-Colonel L. H. Irby in the chair, it was stated that there were 83 additions made to the Society's menagerie during March, amongst which special notice was directed to a kiang, or wild ass of Tibet (*Equus hemionus*). Only two examples of this scarce animal had been previously exhibited in the Society's gardens—namely, in 1859 and 1885. There had also been received an example of Pel's owl (*Scotopelia peli*), a rare species of owl from the Niger territory, presented by Lieutenant E. V. Turner, R.E., and a Cape jumping hare (*Pedetes caffer*), presented by Mr. William Champion, F.Z.S.

In an important paper read by Mr. Charles Heycock before the Royal Institution, recently, a study of the method of union of the constituents of alloys is followed which indicates that the same laws control as in solutions. Gold, for example, dissolves in melted silver, and the temperature of solidification is reduced in proportion to the weight of gold introduced, until a limit is approximated with twenty per cent. gold. This 'law' is verified in the case of a number of alloys mentioned, but not with a few others (as *Sb* in *Bi*). The rate of lowering of temperature in the cases illustrating solution is inversely proportional to the molecular weights of the dissolved metal.

Signor Marconi has successfully communicated from the South Foreland, Kent, to the French armed despatch vessel *Ibis* while sailing in the English Channel.

The scientific library of the late Dr. Stainton, F.R.S., the entomologist, has been sold at auction at London. The following works were included: 'Annals de la Société Entomologique de France,' from the beginning in 1832 to 1892—£35; J. Curtis, 'British Entomology,' 1824–39—£11 5s.; Transactions of the Entomological Society of London, from the beginning in 1836 to 1892, 38 volumes—£32; P. Millière, 'Iconographie et Description de Chenilles et Lépidoptères Inédits,' 1859–74—£10 5s; G. A. W. Herrick-Schäffer, 'Systematische Bearbeitung der Schmetterlinge von Europa,' 1843–56—£27 10s.; and J. Hübner, 'Sammlung Europäischer Schmetterlinge,' Augsburg, 1805, etc., £24.

In his presidential address before the Chemical Society, London, Professor Dewar, as reported in the London *Times*, discussed the means that might be used for measuring the range of temperature between the critical point of hydrogen and the zero of absolute temperature. The electrical resistance thermometer was of great delicacy, but it depended on a knowledge of the law connecting resistance and temperature and involved the necessity of extrapolation. At such temperatures, however, conditions occurred which could not be anticipated, and hence no confidence could be put in the results given by the curve. Platinum, for instance, which was frequently used for the construction of such thermometers, approached its zero of resistance when immersed in liquid hydrogen, and theoretically only required to be cooled five or six degrees further to become a perfect conductor of electricity. Such a reduction should be effected by making the hydrogen boil under exhaustion, but, in fact, the

lowering of temperature indicated by the platinum thermometer in such circumstances did not exceed one degree. Hence the platinum must have come to a limit. Two pure platinum thermometers which Professor Dewar had tried both behaved in this way. Next he experimented with a resistance composed of an alloy of rhodium and platinum, which gave a different temperature altogether. According to it the boiling point of hydrogen was *minus* 246° as against *minus* 238° shown by the pure platinum arrangement, and it, too, failed to indicate the expected lowering under exhaustion. A thermo-junction of iron and German silver was next tried without satisfactory results, and another junction of lead and iridium-platinum proved equally ineffective. Thus he was brought to an air thermometer and the use of hydrogen itself under diminished pressure to determine its own boiling point. In the instrument he had constructed the gas had a tension of 273 mm. at the temperature of melting ice, so that a difference of one millimeter, corresponded to one degree of temperature. The boiling point of hydrogen was by this thermometer given as about *minus* 252°, but various corrections had to be made, and in particular the possibility of the hydrogen being contaminated with a slight impurity of air or oxygen allowed for, so that it was uncertain what exactly was the true boiling point. Assuming it to be *minus* 252°, or 21° on the absolute scale, Professor Dewar went on to illustrate the difficulties of nearer approach to the absolute zero itself. By exhaustion the experimenter could not practically get more than 6° lower, and at that point he was barred and blocked with no means of bridging over the remaining 15°. Even supposing that a new substance was discovered as volatile in comparison with hydrogen as hydrogen was in comparison with nitrogen, that under exhaustion would only give a temperature 3½° above the zero, and it would require a second hypothetical substance as volatile compared with the first as the first was compared with hydrogen to enable the experimenter to come near the extreme of temperature he is aiming at.

THE report by Sir William Crookes, F.R.S., and Professor Dewar, F. R. S., on the composition and quality of daily samples of the water supplied to London for the month ending February 28, 1899, says: We have again to record an excess of rain. The rainfall at Oxford during the past month was 1.92 in., the average fall for the last 30 years is 1.76 in., giving an excess of 0.16 in., and making the excess for the first two months of the year 0.85 in., or 21.6 per cent. on the average fall. It is interesting to observe the effect of the rainfall on the number of microbes in the unfiltered Thames water. No rain fell on the 1st, 2d or 3d, and the average number of microbes in the Thames at Hampton up to the 4th was 6,510 per c.c.; it then rained every day until the 15th, during which time the average number of microbes, including the 16th, rose to 38,354 per c.c.; after the 15th no more rain fell, and the average number of microbes from then to the end of the month fell to 14,914 per c.c. This large increase in the number of microbes in the river, due to rain, originates not merely from the washing of the surface of the land, but is also largely due to atmospheric microbes brought down by the rain. As far as our experiments go they are perfectly harmless. During the month the London waters, chemically and bacteriologically, have maintained their high character as an efficiently filtered river supply.

PROFESSOR E. RAY LANKESTER has written a letter to the London *Times* stating that £3,240 have been subscribed toward a second expedition of Mr. J. E. S. Moore to Lake Tanganyika, and that in addition £500 have been offered on condition that a further sum of £500 be collected. This insures the sending of the expedition regarding the scientific importance of which Professor Lankester writes: Some ten years ago the discovery of a true medusa—similar to some marine jelly-fish—in the waters of Lake Tanganyika led naturalists to entertain the notion that this vast and remote inland sea might retain within its area other evidences of a former connection with the ocean. The medusa (which swarms in the lake at certain seasons) was duly described by Mr. R. T. Günther in my laboratory at Oxford, and named *Limnocnida Tanganyikæ*. So great was the interest felt in the suggestions to which its presence gave rise that I obtained two small

grants from the Royal Society and the British Association, and was fortunate enough to induce Mr. J. E. S. Moore to undertake, in 1896, a journey to Lake Tanganyika in order to collect the fish, shell-fish, medusæ and sponges which occur in its waters. The result of Mr. Moore's careful study of his collections (especially by the examination of the internal anatomy of the whelk-like shell-fish obtained) has been to show that there is in Lake Tanganyika an ordinary fresh-water lake fauna similar to that of other lakes, but that side by side with this there is a second fauna of marine character to which Mr. Moore has given the name 'halolimnic' (oceano-lacustrine). Not only this, but Mr. Moore has shown that the molluscs of the halolimnic fauna of Tanganyika have an extraordinary resemblance to forms occurring in the fossil condition in the inferior oolites of Europe. I have recently placed in the northeast recess of the central hall of the Natural History Museum in Cromwell-road a case showing a series of these Tanganyika shell-fish side by side with examples of the oolitic shells with which they so closely agree. Close to these are placed the fishes brought home by Mr. Moore, of which 26 were new to science. Mr. Moore, in his former visit to Tanganyika, was not able to do more than 'scratch round some 150 miles of the shallow coast line of a lake over 350 miles in length' (to use his own words). Naturally one is led to believe that a more thoroughly equipped expedition with the use of a steamer on the lake (which Mr. Moore had not the chance to obtain) would yield results of proportionately increased importance. It is not merely as adding new forms to our collections that such an exploration is to be desired. The great geological problems of the history of this lake basin and its connection possibly with the Nile or a northward sea, possibly with an ancient estuarine Congo, are what stare us in the face. There are deposits in the valley north of Tanganyika and in its immediate vicinity which must be examined and infallibly yield evidence on these subjects. There are also the northward lakes of Kivu and the Albert Edward Nyanza, the waters of which have never been sampled for their living witnesses of geological history.

UNIVERSITY AND EDUCATIONAL NEWS.

We announced last week that Mr. Astrakoff, the Russian engineer, had left, under certain conditions, 1,000,000 roubles for the foundation of a university for women at Moscow. This trust has been accepted by the Moscow municipality and an annual subsidy of 3,000 roubles has been voted.

The medical library of the late D. Sigismund Waterman, of New York, has been bequeathed by him to Yale University.

A friend of Princeton University whose name has not been disclosed has given $100,000 to establish a chair of politics. It is reported that the chair is for ex-President Cleveland.

Professor H. P. Hutchins, Dean of the Law Department of the University of Michigan, has been elected President of the Iowa State University.

Dr. Henry L. Wheeler, instructor in organic chemistry in the Sheffield Scientific School of Yale University, has been promoted to an assistant professorship.

At Colorado College Dr. Florian Cajori, formerly professor of physics, has been transferred to be head of the department of mathematics, and Dr. S. J. Barnett has been promoted to the professorship of physics.

Major Ross, known for his work on the malarial parasite, has been elected lecturer in the newly established School of Tropical Medicine at Edinburgh.

Dr. Oskar Doebner has been promoted to a full professorship of chemistry and pharmacy in the University of Halle. Dr. Kunz-Krause, of Lausanne, has been appointed professor of physics in the veterinary school at Dresden. Dr. Beck von Managetta, of the University at Vienna, has been made professor of botany in the University at Prague. Dr. Sommer and Dr. Cohen have qualified as docents in geometry and physics respectively in the University of Göttingen. Professor Heinrich Ritthausen, professor of agricultural chemistry in the University at Königsberg, has retired.